XXII. *Proceedings relative to the Accident by Lightning at* Heckingham.

LETTER FROM THE BOARD OF ORDNANCE.

SIR,

HAVING received information that, laſt ſummer, a ſtroke of lightning ſet fire to the Poor-houſe at Heckingham, near Norwich, notwithſtanding it was armed with *eight pointed conductors*, we requeſt you will communicate to us ſuch particulars relating to that fact, as may have come to your knowledge.

We are, with great reſpect,

SIR,

Your moſt obedient humble ſervants,

AMHERST.
CHARLES FREDERICK.
H. STRACHEY.
J. KENRICK.

Office of Ordnance,
22d December, 1781.

Sir Joſ. Banks, Bart. Preſident of the Royal Society.

Extracts

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Extracts from the Minutes of the Council of the Royal Society.

January 10, 1782.

THE Preſident laid before the Council a letter to him from the Board of Ordnance, acquainting him, that the Poor-houſe at Heckingham, near Norwich, had been ſtruck by lightning, notwithſtanding it was armed with eight pointed conductors; and requeſting him to communicate to them ſuch particulars relating to that fact as may have come to his knowledge.

Reſolved,

That Dr. Blagden and Mr. Nairne be requeſted to repair to Heckingham, and examine into the circumſtances of the accident, and report thereon to the Council: that they engage a draughtſman, to take ſuch drawings as may be requiſite; and that the neceſſary expences be defrayed by the Society.

February 7, 1782.

Dr. Blagden read to the Council his and Mr. Nairne's Report of the Survey made by them of the Poor-houſe at Heckingham in Norfolk, in conſequence of their appointment by a former Council. The ſaid Report was ordered to be read to the Society on Thurſday the 14th inſtant. And the Preſident was requeſted to tranſmit it immediately afterwards to the Board of Ordnance; and to deſire that they would return the drawings as ſoon as they ſhould have taken copies of them, or made ſuch other uſe of them as they might think neceſſary.

Report of the Committee.

Read February 14, 1782.

To the Preſident and Council of the Royal Society.

GENTLEMEN,

PURSUANT to your reſolution, appointing us a committee to examine the Houſe of Induſtry at Heckingham in Norfolk, which had been ſtruck by lightning although it was armed with conductors, we arrived there on the 21ſt of January. Seven months had then elapſed ſince the accident, yet we had the ſatisfaction to learn, that no material changes had been made in the conductors or the building in that period; ſome laths that had been burnt, ſome bricks and pantiles which had been damaged or thrown down, were replaced; but we found means to procure diſtinct information of thoſe repairs from the workmen who had been employed to execute them. In order to communicate a clear idea of the accident, it will be neceſſary to premiſe a general account of the building; then to repreſent the manner in which the conductors were applied; and, laſtly, to deſcribe the ſtroke of lightning, with its effects.

The general form of the building is that of the Roman letter H (ſee the general plan, fig. 1.), conſiſting of a center range (Z) and two flanks (Y and X). It ſtands on a gentle riſing, which can by no means be termed a hill, with its front facing S. 9° W. To the weſtern ſide of the weſt flank, and eaſtern ſide of the eaſt flank, ſome lower buildings are annexed, ſerving as offices of different kinds; and there are two courts, one before and the other behind the houſe, together with ſome ſmall gardens and yards on each of the flanks, in all of which ſtand various detached offices, as will be eaſily conceived from the general plan (fig. 1.).

The body of the building, including the great houſe with its annexed offices, is provided with eight chimnies, the poſition of which is repreſented in the plan (fig. 1.) at the letters A, B, C, D, E, F, G, H. Of theſe the ſix firſt are all placed on the ridges of the roof; namely, A and B on the ridge of the weſt flank, C and D on the ridge of the center range, and E and F on the ridge of the eaſt flank; but the chimney G riſes from the lower part of the roof on the eaſtern ſide of the eaſt flank; and the chimney H from the roof of an annexed office, the boiling-room, which roof is continued down from the general roof, and projects beyond it.

Both flanks (X and Y, fig. 1.) at their north and ſouth ends are hipped off from the ridge of the roof to the eaves on each ſide; conſequently there are eight hips, all of which are covered or *coped* with lead; the four vallies alſo, formed by the interſection of the center range with the two flanks (ſee fig. 1.) are in like manner covered with lead, which here anſwers the purpoſe of a ſpout. (Two of theſe hips are ſhewn in the 2d, 3d, 4th, and 11th figures at *h*, *h*, and one of the vallies at *v*, fig. 2.) Thoſe twelve ſtrips of lead, covering the hips and the vallies (ſee the general plan, fig. 1.), are all ſeparate, not having any metalline communication with one another, as the reſt of the roof conſiſts merely of pantiles, with dropping eaves.

From the ſouth-eaſt corner of the eaſt flank a wall is continued eaſtward (ſee I in the 1ſt and 3d figures) above 26 feet in length, having a ſmall garden at its ſouth ſide, and on the north a ſtable built againſt it as a *lean-to* (K in the 1ſt and 4th figures); which ſtable is alſo ſupported on the weſt by the eaſt wall of the eaſt flank of the building (fig. 1. at *t*). The roof of the ſtable being like that of a ſhed, ſlopes downward from ſouth to north (*a* and *b* in the 4th and 11th figures); it does not reach up quite to the top of the wall againſt which it reſts to the ſouthward, but is ſhorter by one courſe of bricks on edge (ſee fig. 10. and 11. at *c)*; and at its junction with the wall a *flaſhing* of lead is carried along horizontally (from *c* to *d*, fig. 11.) 25½ feet in length.

We conclude this general account of the building with the dimenſions of its principal parts.

	Ft.	In.
Length of the center range (Z fig. 1.) to the flanks - - - - -	108	9
Length of each flank (X and Y fig. 1.) -	159	7
Breadth of the center range, and of each flank,	31	4
Height from the ground to the bottom of the hips (*g*, *g*, fig. 3. and 4.) - - about	20	6
Height from the ground to the top of the ridge (*f*, fig. 2. and 3. *e*, fig. 4.) - about	34	0
Height of the chimnies above the ridge of the roof (as E, fig. 4.) - - about	3	6
Length of each hip (from *f* to *g*, fig. 3. 4. and 11.) - - - about	27	0
Height of the wall (I) ſupporting the ſtable (fig. 3.)	16	0
Height of the eaves of the ſtable above the garden to the northward of it (ſee general plan, fig. 1.)	7	0
Length of the ſtable on the outſide -	26	2
Breadth of the ſtable on the outſide -	15	5

To all the eight chimnies which have been deſcribed we found iron rods affixed, reaching between four and five feet above the top of the chimney, pointed at the upper end, and tapering about ten inches to that point. Each rod or bar was nearly ſquare, meaſuring, upon a mean, about half an inch one way, and four-tenths of an inch the other, with the angles juſt rounded off. Theſe conductors were continued down the building by a ſucceſſion of ſimilar bars of iron, in general from ſix to eight feet long, joined to one another by two hooks and nuts (ſee fig. 12.); that is, the correſponding ends of each bar being formed into a hook bent at right-angles, the hook of the uppermoſt went into a hole of the lowermoſt, where it was faſtened with a nut, and the hook of the lowermoſt went into a ſimilar hole of the bar above, where it was fixed in the ſame manner; the length of each of theſe joints, from nut to nut, was about two inches.

Though there were eight of theſe conductors reaching above the chimnies, yet they had only four terminations below. For the conductors to the two chimnies D and E (fig. 1. and 2.) being continued toward each other along the roof, united in the valley over the lead gutter there (at L in the 1ſt, 2d, and 3d figures), and from that point only one conductor was continued down the valley toward the ground. In like manner the two conductors from the chimnies A and C (fig. 1.) united in the valley of the roof between them, and were carried down toward the ground as a ſingle rod. All the three conductors from the chimnies F, G, and H, ſucceſſively joined together (ſee M, N, fig. 1.), and only a ſingle rod was continued from them down the lower part of the building. Laſtly, the conductor from the chimney B (fig. 1.) went down ſingle all the way, without having formed a junction with any other.

As the conductors, therefore, in their paſſage down the building, were thus reduced to four, we are now to ſhew their four terminations. And, firſt, that from the chimney B, being the ſimpleſt, was carried down the weſtern ſide of the weſt flank, till it came very near the ground, when it entered a ſmall channel of brick-work, through which it was continued under the pavement into a narrow bricked drain, leading

through

through the wall of a privy (at O, fig. 1.) into which the drain diſcharges itſelf. The conductor having paſſed, in the drain, through the hole in the privy wall, was continued about three feet into the open ſpace under the ſeat of the privy, where it terminated in air, none of the ſolid work being nearer its end than ſix inches. As this drain is conſtructed to receive the foul water from the yard, and one of the water-cocks is near, ſome moiſture will moſt commonly be found in it; but the ſtones ſlope ſo rapidly at the termination of the drain in the privy, that any water which runs thither muſt be immediately carried off. This conductor, as well as all the others, was kept in its place near the wall in its paſſage down, by ring-ſtaples driven into the wall.

The ſecond termination we ſhall deſcribe is that belonging to the chimnies F, G, H (fig. 1.). The conductor from the chimney F in paſſing down the roof was joined by that from the chimney G (at M, fig. 1.) and afterwards by the rod from the chimney H (at N, fig. 1.); thence the iron was continued down till it came near the bottom of the wall, where it was turned off along the pavement toward a ſink (fig. 1. Q) not quite two feet diſtant, through the ſide of which it was carried, and projecting four inches into the open ſpace of the ſink, there terminated in air. The ſink is built of brick, one foot nine inches deep, and two feet and a half ſquare within; and into its ſouth ſide is fitted an iron grate, of the ſame length as the ſide externally, and about ſeven inches deep, the lower part of which lies on the bare ſoil. Through the middle of this grate the conductor paſſes, reſting in contact with one of the bars. From its termination to the bottom of the ſink is not leſs than twelve inches; and the bottom, which is of brick, ſlopes ſo much, that water can never lie upon it, there being a large drain on the further ſide, which leads off from the bottom of the ſink.

The third termination to be inveſtigated is that formed by the conductors from the chimnies A and C (fig. 1.). Theſe, after joining in the valley which lies between them, ran down, as a ſingle rod, over the lead covering the valley, paſſed through a hole in that lead, where it projects over as a ſpout, and deſcended in the angle formed by the interſection of the weſt flank with the front of the center range (S, fig. 1.). Being arrived within eight inches of the ground, it entered a narrow channel of brick-work, through which it was conveyed into a ſmall cloſe drain or gutter, where it terminated, with a hooked end, in contact with one of the ſide bricks. It touched nothing ſolid, therefore, in its courſe under the ground, but brick-work. The ſmall drain in which it terminated was ſo placed as not to receive much moiſture; and this drain led into the ſide of a grated ſink (U, fig. 1.), at the bottom of which the great drain of the fore-court begins.

Of the ſeveral conductors that have been hitherto conſidered, the different parts of the building to which they were affixed, and their reſpective terminations, very accurate drawings were made on the ſpot; but as theſe conductors were more diſtant from the ſtricken end of the houſe than thoſe which remain to be deſcribed, and alſo ſhewed no marks of having been affected by the ſtorm, we thought it unneceſſary to enter into a more circumſtantial detail regarding them; eſpecially as, if any further particulars ſhould appear hereafter to be of conſequence, it will at all times be eaſy to refer to the original drawings and notes.

We proceed now to examine the fourth termination, by which the conductors from the chimnies D and E (ſee fig. 1.

and 2.), being thoſe neareſt the ſtricken corner, were carried under the ground. The conductor of the chimney D, from its upper point to its final termination, conſiſted of ten bars, into the ſixth of which the conductor coming from the chimney E was faſtened by its fourth bar, reckoning from the top (at L, fig. 1. and 2.). This junction was made by a hook at the lower end of that fourth bar of the conductor from the chimney E, which hook was received into a hole of the abovementioned ſixth bar, and fixed there by a nut underneath. Here was, therefore, only one hook and nut, inſtead of two as in the common joints. Alſo at the top of this ſixth bar of the conductor from the chimney E, where it united with the fifth bar, only one hook and nut were employed to form the junction, the other hook appearing never to have been put into its correſponding hole. In this ſame ſixth bar, above the hole into which the conductor from the chimney E was inſerted, we found four other ſpare holes, which were left quite empty.

Tracing the conductor downward from this point of union, we found it deſcend over the lead of the valley, to the ſurface of which it gradually approached, till at a hole made on purpoſe (*m*, fig. 2.) it paſſed through the lead, whence it was continued down the angle formed by the interſection of the eaſt flank with the front of the center range (T, fig. 1. 2. and 5.). It no where touched the wall of the building, but was kept in its place by ring-ſtaples (*p*, *p*, fig. 3.). Being arrived within two or three inches of the ground, it entered into a channel of brick, encloſed on all ſides (at *e*, fig. 5.), in which it was continued down to the arch of the great drain of the fore-court (*x*, fig. 5.); here, having paſſed through a hole in the haunch of the arch (*y*, fig. 5. and 7.), it was bent off from the houſe through the middle of the drain, and ultimately terminated in contact with the bricks at the bottom of it (at *z*, fig. 5. and 7.). This conductor, therefore, in its paſſage downward, did not communicate, till it reached the bottom of the drain, with any thing better able to carry off electricity than maſonry or timber; for the iron-ſtaples faſtening it to the wall, and the lead lining the valley, were themſelves in contact with ſuch ſubſtances only.

As this drain, then, is the real termination of the conductor, it muſt now be more attentively conſidered. It begins at the weſtern ſink of the fore-court U (fig. 1.); thence it is continued (V, V, fig. 1.) with a proper declivity to the eaſtern ſink W (fig. 1. 5. and 6.); it then runs under the eaſt flank of the houſe (V 2, fig. 1. and 5.), and ends beyond it in the ſide of the ceſs-pool P (fig. 1.). From the grating on the ſink U to that on the ſink W (fig. 1.) is 89 feet, and thence to the ceſs-pool P near 69 feet; the breadth of the drain at bottom (*z*, fig. 7.) is 14 inches; its height to the ſpring of the arch (fig. 7.) 16 inches, and to the crown of the arch (*x*, fig. 5. and 7.) 23 inches. When we ſaw it, the moiſt filth, or ſludge, at bottom (*z*, fig. 7.) was two or three inches deep; but when the court is overflowed, as the two grates (at U and W, fig. 1.) are laid on purpoſe to receive the ſuperfluous moiſture, there muſt be ſome run of water through it. We eſtimated the fall of the drain, from the eaſtern ſink W (fig. 1.) to its termination in the ceſs-pool P, at two feet. The ceſs-pool itſelf reſembles a well, walled round in the inſide, and has foul water ſtagnating at the bottom, which cannot riſe above a certain height on account of a large drain, leading from it into the great reſervoir (at R, fig. 1.), out of which the foul water is ultimately pumped. When we examined this ceſs-pool, the water in it ſtood even with the bottom of that great drain, conſequently was almoſt as high as it could be, unleſs the drains ſhould at any time be flooded; and upon meaſuring the diſtance from the bottom of the drain coming from the fore-court (V2, fig. 1.) where it terminated in the ſide of the ceſs-pool, down to the ſurface of the water ſtagnating in the ceſs-pool, we found it 3½ feet. This interval, therefore, of three feet and a half muſt be paſſed through, to form a communication between the water in the drain, and that in the ceſs-pool. The drain is firmly built of brick and mortar (ſee the ſection of it, fig. 7.). To determine the nature of the ſoil in which it is laid, a hole was dug in the fore-court ſeven feet deep, where we found nothing but ſand, at this time pretty moiſt, with a few pebbles. There is reaſon to believe, however, from the ſoil of an adjacent declivity to the northward, that below the ſand, perhaps at the depth of 15 or 16 feet, a bed of clay would be found.

Againſt the eaſt flank, near the corner T (fig. 1.), there riſes a leaden pipe with a cock (O, fig. 2.), to which the water is conveyed from a raiſed ciſtern (ſee *r*, fig. 1.) in one of the detached offices of the back-court. A main of lead from the ciſtern, which is itſelf of that metal, after ſending out pipes to ſome other cocks, and paſſing through the cellars of the houſe, comes into the fore-court about four yards from the corner T (fig. 1.) and is carried over the drain at the diſtance of about a foot above its crown, and eight inches below the ſurface of the ground. Here it divides into two branches, one of which goes ſtraight to the cock at O (fig. 2.), and the other runs weſtward, to ſupply a ſimilar cock in the oppoſite corner. We meaſured the diſtance of theſe pipes and cocks from the conductors, and found that they came no where nearer than five feet and an half.

Such were the conductors that, in the month of June, 1777, ſeveral years after the Houſe of Induſtry had been built, were erected with the hope of guarding it from lightning. The iron of which they were formed had in that time acquired a coat of ruſt, ſuch as might be expected from four years expoſure to the air. On the 17th of June, 1781, after a ſhowery forenoon, a heavy cloud having riſen from the S. W. brought on a ſevere thunder-ſtorm, attended with ſuch heavy hail and rain, that the court before the houſe was overflowed. At length, about three in the afternoon, when this ſtorm had already laſted 15 or 20 minutes, a ſingle and very loud exploſion was heard, like the report of a cannon, which exceedingly terrified all the people in the houſe, and affected three of the paupers ſo much that they fainted. At the ſame time a great light was perceived, which ſeemed, as they expreſſed it, to come in at the windows; and ſtill more at the doors of the rooms, like a ſheet of fire. Within one or two minutes, the ſouth-eaſt corner of the eaſt flank of the building was obſerved to be on fire, the flame burſting out at the bottom of the hip (ſee *g* in fig. 3. 4. and 11.). By the briſk exertions of the people in the houſe, this fire was quickly extinguiſhed; and the court was ſo overflowed, that they procured ſufficient water for that purpoſe by means of a hole which they dug near the burning corner of the building. The ſtorm, and eſpecially the rain, continued ſome time after the ſtroke, but not with ſuch violence as before. At the moment of the exploſion it was nearly calm; but the wind had been ſouth-weſterly all day, and the ſky was obſerved to be clearing in that quarter about the time of the accident.

To come at the fire, in order to extinguiſh it, the lead had been rolled off the bottom of the hip, and ſome bricks thrown down, all of which were replaced when we arrived at Heckingham; but as the men, who had gone up to the corner of the houſe on the firſt appearance of the fire, ſeemed to recollect very well the ſtate in which they had found the lead and tiles at that moment, they were deſired to put every thing in the ſame ſtate to the beſt of their memory. With this view they turned back the lead at the bottom of the hip on its ſouth ſide, ſo that the ſouth-weſt face of the hip-pole might be ſeen, and threw down a few tiles, after ſetting one on edge againſt the hip-rafter. The lightning then, if ſuch evidence be admitted, had raiſed up that corner of the lead to the breadth of about ſix inches at the bottom, and diſplaced ſome tiles. An effect of this kind upon the lead, is one of the commoneſt facts obſerved in buildings that have been ſtruck by lightning. It ſo happened, that the piece of lead which we found on the bottom of the hip at Heckingham, had upon it ſeveral impreſſions or pits; concerning which various opinions were entertained, till an experiment, made ſince our return to town, ſeems to have put it beyond doubt, that they are nothing but marks of large ſhot, ſuch as might have been produced by firing, with a large fowling-piece, at a bird ſitting on the corner of the houſe. All the people who aſſiſted in extinguiſhing the fire agreed, that on the eaſtern ſide of the hip, the lead remained, after the ſtroke, in its uſual ſituation.

On removing entirely the lower part of the lead, no kind of damage was ſeen on the wood of the hip-pole, except that near the lower end it was ſlightly ſcorched in one place, apparently by the flame which had burſt forth from below; the ſpike-nail which had faſtened the lead to it appeared perfectly ſound, and even the hole made by that nail in the wood was neither burnt nor ſplintered. This hip-pole was ſupported, at its proper diſtance from the hip-rafter, by an iron-ſtrap, or holdfaſt, which was driven into the timber making the tie of the angle, through the bevelled end of the hip-rafter, juſt without the part where the tenon of the latter is received into the mortiſe of the former (*a*, fig. 8.). Here it was that the fire ſeemed to have begun, though neither the holdfaſt itſelf, nor the hip-pole reſting upon it, ſhewed any ſigns of the lightning. From the place into which this holdfaſt was driven (*a*, fig. 8.) to the outer end of the angle tie (*b*, fig. 8.) there was a conſiderable loſs of ſubſtance, occaſioning a large hole; but the ſides of the hole within were ſo ſmooth, and ſo little charred, ſhewing plainly the grain of the wood, that it was ſcarcely poſſible to ſuppoſe the whole had been *burnt* out; we conjectured, therefore, that a large ſplinter had been forced off by the lightning at this place, and, in the ſame moment, the tenon of the hip-rafter ſet on fire where it enters the mortiſe. Indeed, unleſs ſome opening had been made by forcing out ſuch a piece, it does not appear how the fire could have burnt, for want of air, in a part that is always ſo cloſely joined by builders: and yet, in this confined place, the tenon of the hip-rafter was ſo far conſumed, that a ruler could be thruſt in, almoſt to the further extremity of the mortiſe. From this ſpot the flame ſeems to have iſſued out eaſtward, between the tie of the angle and the wall-plate (*c*, *c*, fig. 8.) ſcorching all the timbers it could reach, and ſetting fire to the laths; but the miſchief it had done was very trifling (ſee fig. 8.).

Juſt beneath the abovementioned hole at the end of the angle-tie (*b*, fig. 8), is the extremity of the wall-plate which lies upon the eaſtern wall of the eaſt flank (*d*, fig. 8.). The end of this wall-plate was rent in a remarkable manner (*e*, *e*, *e*, *e*, fig. 8.), and ſeveral of the fiſſures were continued ſome way upon the ſides (*d* and *f*, fig. 8.). Though the other timbers we have mentioned are of fir, the wall-plate is of ſolid oak; and the violence done to its extremity was ſuch, that we could not doubt but it had been occaſioned by the lightning.

Under this end of the wall-plate there was a crack in the ſouth face of the corner (*m*, fig. 8.), which went down four courſes of bricks, and then terminated abruptly (*m*, fig. 3.). The three external courſes of bricks above this crack were new, and projected out much farther than the others, to form the cornice of the wall. Whether the bricks of the old cornice had been damaged or thrown down by the ſtroke, we could not learn with certainty; but the general report among the people we conſulted was, that they had not, and were only taken down to extinguiſh the fire: this opinion ſeemed probable from the want of marks on the hip-pole which projected out with the cornice, and the appearance of ſuch ſtrong effects of lightning on the wall-plate which lay within any part of the projection; whence it might be concluded, that the lightning paſſed within the cornice, and no where through it. Between the bottom of the wall-plate, and the top of the crack where it appeared to begin at the foot of the cornice (*m*, fig. 3. and 8.), lay two inner courſes of bricks (*o* and *p*, fig. 8.) covered by the cornice. Some damage had evidently been done to the bricks in this part, though we could not diſtinctly trace the progreſs of the lightning through them.

Beneath the eaſt edge of the wall-plate, and ſeparated from it in like manner by two courſes of bricks, a ſimilar crack deſcended from the bottom of the cornice (*l*, fig. 4. and 8.) on the eaſt face of the corner, and went through ten courſes of bricks till it reached the top of the wall that ſupported the ſtable. Here the three bricks next the houſe, it is ſaid, were ſhivered into pieces as ſmall as nuts, but not thrown off (*c*, fig. 10. and 11.). The cracks in the bricks on both faces of the corner remained, having only been filled up with mortar; but new bricks were put in the place of the three that had been broken on the wall. All the workmen we ſaw agreed in opinion, that no iron cramps, or other metal, had been uſed in the brick-work.

Beginning from theſe three ſhivered bricks on the top of the wall, three courſes of pantiles on the roof of the ſtable, in the direction downward, were in great meaſure broken or diſplaced, except about two feet of the lower end of the courſes, near the eaves, where the tiles remained untouched (ſee *c*, *m*, *g*, *q*, fig. 10. and *c*, *q*, fig. 11.). All theſe pantiles reſted upon laths, which were faſtened to the rafters of the roof by iron nails about eleven inches aſunder. Within the ſtable, and almoſt underneath the ſpot where the damage to the pantiles ceaſed, a ſaddle hung, at the time of the accident, by a nail driven into the wall at that weſt end of the ſtable, which was alſo the eaſtern wall of the eaſt flank of the houſe (*n*, fig. 10.). As this ſaddle, being much torn by the lightning, ſeems to have been the ſtep by which it paſſed through the ſtable, the reſpective ſituations of all their parts ſhall be minutely deſcribed.

The ſtable in its inſide is 25 feet long (from *r* to *s*, fig. 9.), 13 feet broad (from *t* to *u*, fig. 9.), 15½ feet high on its ſouth ſide (from *w* to *x*, fig. 10.), and 7½ feet on the north (from *y* to *z*, fig. 10.). At the weſt end is a ſtall for one horſe (*s*, fig. 9.). Near the middle of the north wall is a drain (*y*, fig. 9. and 10.), which terminates juſt without the wall in the garden (*k*, fig. 9. and 10.). Againſt the weſt end of the ſtable, a ſhelf (*e*, *f*, fig. 10.) was ſupported by two nails underneath (*f*, fig. 10.). Seven inches and a half below this ſhelf was a nail, on which the ſaddle hung by one of its ſtirrups (*n*, fig. 10.). The breadth of the ſhelf was near one foot and an half; its length (from *e* to *f*, fig. 10.) two feet five inches; and the pantiles ſeem to have been diſplaced a little farther down on the roof (*g*, fig. 10.) than the line correſponding perpendicularly with the north end of the ſhelf (*b*, fig. 10.). Neither the ſhelf, nor the nails ſupporting it, which were both near its north end, ſhewed any ſigns of injury; whence it may be conjectured, that if the lightning took its courſe this way, it paſſed obliquely between the ſaddle and the roof, ſo as to miſs the edge of the ſhelf, leaving it to the ſouthward. The upper part of the ſouth ſide of the ſtable was boarded off from the reſt, to form a hay-chamber, which occupied ſo large a portion of the roof (from *x* to *m*, fig. 10.), that the boards of the perpendicular partition (at *o*, fig. 10.) came within ten inches of the nail on which the ſaddle hung. Theſe boards were faſtened to the uprights of the partition, all the way down from the roof, by nails about ſix inches aſunder, conſequently ſome of thoſe nails muſt have been within ten inches of the ſtirrup-iron as it hung on the nail in the wall (*o* and *n*, fig. 10.). No tokens of the lightning could be diſcovered on thoſe boards, or the nails faſtening them; we could not, therefore, be certain, whether any part of it had paſſed that way. The nail which ſupported the ſaddle was equally free from marks; but one of the ſtirrup-leathers was much torn and burnt, and a large piece of the leather was ſtripped off the ſeat of the ſaddle, beſides other damage done to it in that part. One of the ſtirrup-irons, likewiſe, exhibits ſome appearances of fuſion on the arch through which the ſtirrup-leather paſſes. This iron, as well as the ſtirrup-leather, being the only damaged parts of the ſaddle that remained, we have brought for your inſpection.

It muſt be evident that we derived the knowledge of moſt of theſe circumſtances relative to the effects of the lightning upon and within the ſtable from information, the damages having been repaired before our arrival. As the workmen preſent, however, agreed pretty well in their teſtimony, and it was corroborated by every thing that appeared, we deſired them to replace all the parts as they were left by the accident, and thence made the deſcriptions and drawings. We gave directions that a man, accuſtomed to the ſtable, ſhould hang up the ſaddle there in the uſual manner, and then aſcertained the following meaſures:

	Ft.	In.
From the nails ſupporting the ſhelf in the ſtable (at *f*, fig. 10.) to the neareſt nails of the pantile laths of the roof (about *h*, fig. 10.) - -	1	3
From the ſouth end of the ſhelf (*e*, fig. 10.) to the roof over it (*m*, fig. 10.) - -	2	1
N. B. The ſouth end of the ſhelf was fixed to the partition-boards of the hay-chamber (*e*, fig. 10), and the two nails under its north ſide (*f*, fig. 10.) were 5½ inches apart.		
From the neareſt of the nails ſupporting the north end of the ſhelf (*f*, fig. 10.) to the nail on which the ſaddle hung (*n*, fig. 10.) - -	0	8
Length of the ſtirrup-iron below the nail (*n*, fig. 10.) - - - -	0	3½
Length of the ſtirrup-leather, from the ſtirrup-iron to the ſeat of the ſaddle - -	1	9
Breadth of the ſeat of the ſaddle - about	0	8
Diſtance from the lower ſide of the ſeat, as the ſaddle hung, to the bottom of the loweſt ſtirrup-iron (*p*, fig. 10.) - - - -	2	0
Diſtance from the loweſt ſtirrup-iron (*p*, fig. 10.) to the floor of the ſtable (near *d*, fig. 10. and 9.) - - - - about	3	6

As the ſaddle was thus placed by recollection, the girths reached from it to the ground (*d*, fig. 10. and 9.); but neither theſe girths, nor any other part of the ſaddle, except one ſtirrup-iron, one ſtirrup-leather, and the ſeat, were ſaid to have been damaged by the accident.

From the quantity of rain which fell in the thunder-ſtorm, the ſtable was overflowed with water, which gradually ſunk into the drain (at *y*, fig. 9. and 10.). The leather ſtripped off the ſeat of the ſaddle was found in the ſtable near this drain; whether thrown there originally, or carried by the water, is uncertain. From the point of the floor immediately under the ſaddle, to the neareſt part of the drain, was about 12½ feet; the width of the drain (*y*, fig. 9.) 14 inches; its length through the wall to the edge of the hole or ſink into which it diſcharges itſelf 18 inches, and the depth of the ſink from the bottom of the drain about one foot and an half. As this ſink was merely a hole, without any drain leading *from* it, and was bricked at the ſides, the water could not paſs off by the drain of the ſtable any faſter than it could ſoak through the looſe ſoil at the bottom of the ſink. And it is evident, from this conſtruction, that the earth under the ſink will uſually be ſome of the wetteſt near the building, and be impregnated with ſalts from the ſtale of the horſes.

Except the marks which have been already deſcribed, we could not find on any part of the ſtable, either within or without, the leaſt veſtige of the lightning. We particularly examined the lead *flaſhing* on the top of the roof (from *c* to *d*, fig. 11.), and the hay-chamber immediately under the three broken bricks and the diſplaced pantiles, but in vain. There was a hook fixed in the wall, 15 inches below the nail on which the ſaddle hung, and ſo exactly underneath, that the ſtirrup-leather may be ſuppoſed to have covered it; but this alſo appeared to be perfectly untouched. After making every poſſible inquiry, we could not determine by evidence, whether the ſtirrup-leather which is ſo ſinged and torn was the upper or the lower one at the time of the accident. Much leſs could we get information of the reſpective poſitions of the two ſtirrup-irons. But, whatever their ſituation may have been, as ſo few ſteps were to be traced, it would ſeem that the lightning muſt have jumped over at leaſt one long interval in its paſſage through the ſtable.

About ſeven feet from the ſtricken corner of the building, and almoſt two feet from the neareſt part of the roof of the ſtable, is a window (A, fig. 4. 10. and 11.) being the ſouthernmoſt of the upper range on the eaſt face of the flank. It has thirty ſmall panes of glaſs, ſet in lead. We were informed, that about half of theſe had been broken by the accident, chiefly on the ſide next the corner; and that the fiſſures ran in general horizontally, nearly parallel. Very little, if any, of the glaſs was forced out. As we could not diſcover any trace of the lightning directly toward this window, a ſuſpicion aroſe, whether it might not have been broken rather by the general concuſſion than by any immediate ſtroke.

Having examined all the marks that appeared between the bottom of the ſtricken hip and the ground, our next inquiries were directed to the top of the hip (*f*, fig. 2. 3. 4. and 11.). Here the upper plate of lead (*e*, fig. 4.) which ſerved as a capping to the junction of the hip with the ridge of the roof, being taken off, we found, on its under ſurface, three diſtinct marks of fuſion; and on the upper ſurface of the ſheet of lead which it covered three correſponding marks, ſo exactly ſimilar, that the two ſurfaces of lead ſeem to have touched one another in a melted ſtate. Theſe fuſed ſpots are juſt in the bend of the lead, anſwering to the obtuſe angle formed between the hip and the roof (*f*, fig. 4.). We obtained leave to bring away both the pieces of lead, and now preſent them for your inſpection. The workmen who examined the timber underneath reported, that it was not damaged; nor were any other ſigns of the lightning perceived in the whole length of this ſtrip of lead from the top to the bottom of the hip. In the pieces of lead which exhibit the melted ſpots on one ſurface, the other ſurface is perfectly clear of all marks, though the latter was, in the uppermoſt plate of lead, that which had lain expoſed to the clouds. Neither of them is melted to any depth into the ſubſtance of the metal.

As both extremities of the hip, therefore, were, in ſome degree at leaſt, affected by the lightning, we proceeded to aſcertain their diſtances from the neareſt conductor, which was that affixed to the chimney E (fig. 2. and 4.). Having determined the neceſſary meaſures, and calculated the hypotenuſe, the diſtance from the point of the conductor to the beginning of the lead on the top of the hip (*e*, fig. 4.) came out 42 feet and a quarter; thence to the bend where we found the marks of fuſion (from *e* to *f*, fig. 4.) was five or ſix inches more; and as the hip meaſured about 27 feet in length, the diſtance from the conductor to the bottom of the hip (*g*, fig. 4.) may be called 69 feet. From the top or bottom of the hip, to the neareſt part of the conductor as it ran downward, the diſtances were not a foot leſs than theſe meaſures. We then took down the uppermoſt rod of the conductor, and carefully examined it, eſpecially at the point, and at the hook and ſcrews by which it had been joined to the ſecond rod; but could no where diſcover the leaſt mark of fuſion or other injury. At the bottom of this conductor, however, where, having joined that from the chimney

D,

D, it terminated in the drain (ſee the general plan, fig. 1. and *z*, fig. 5.), a ſmall bright ſpot appeared on one of the angles. As ſome ſuſpicions were entertained, whether this mark might not have been occaſioned by the lightning, we cut off the end of the rod, and have brought it hither for public examination.

Where this conductor entered its channel at the corner of the court (ſee T, fig. 1. and *e*, fig. 2. and 5.), the ground is raiſed ſo much above the grate of the ſink (W, fig. 1. and 5.) that, though the court was overflowed, it is not probable, the water could have riſen high enough to run into the channel (at *e*, fig. 5.), and ſo communicate with the conductor before it reached the drain.

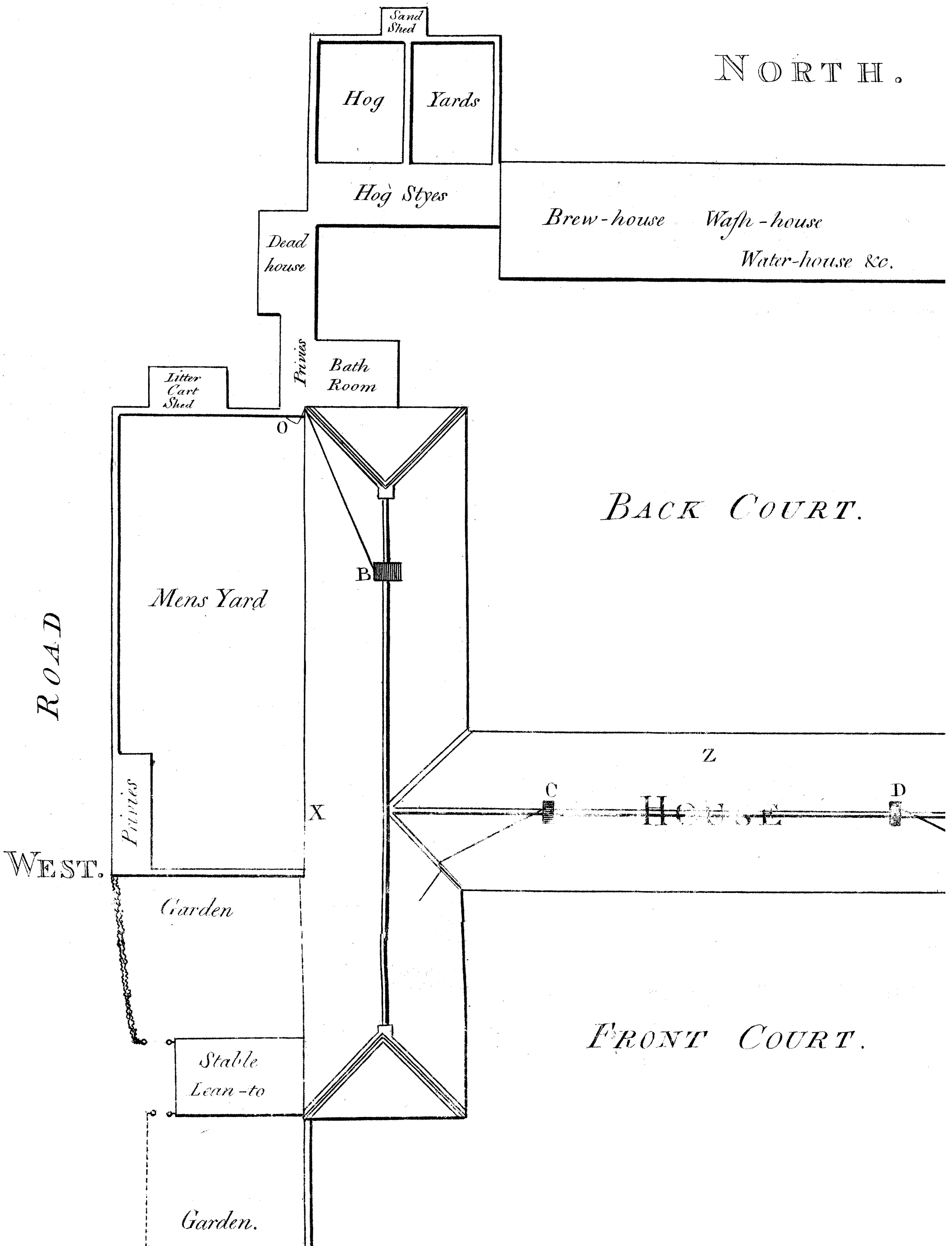
Cloſe to the chimney E, a dinner-bell hung in a common frame (*q*, fig. 2. and 4.). Three different perſons went up to examine this bell; but could not diſcover upon it any where the leaſt veſtige of the lightning.

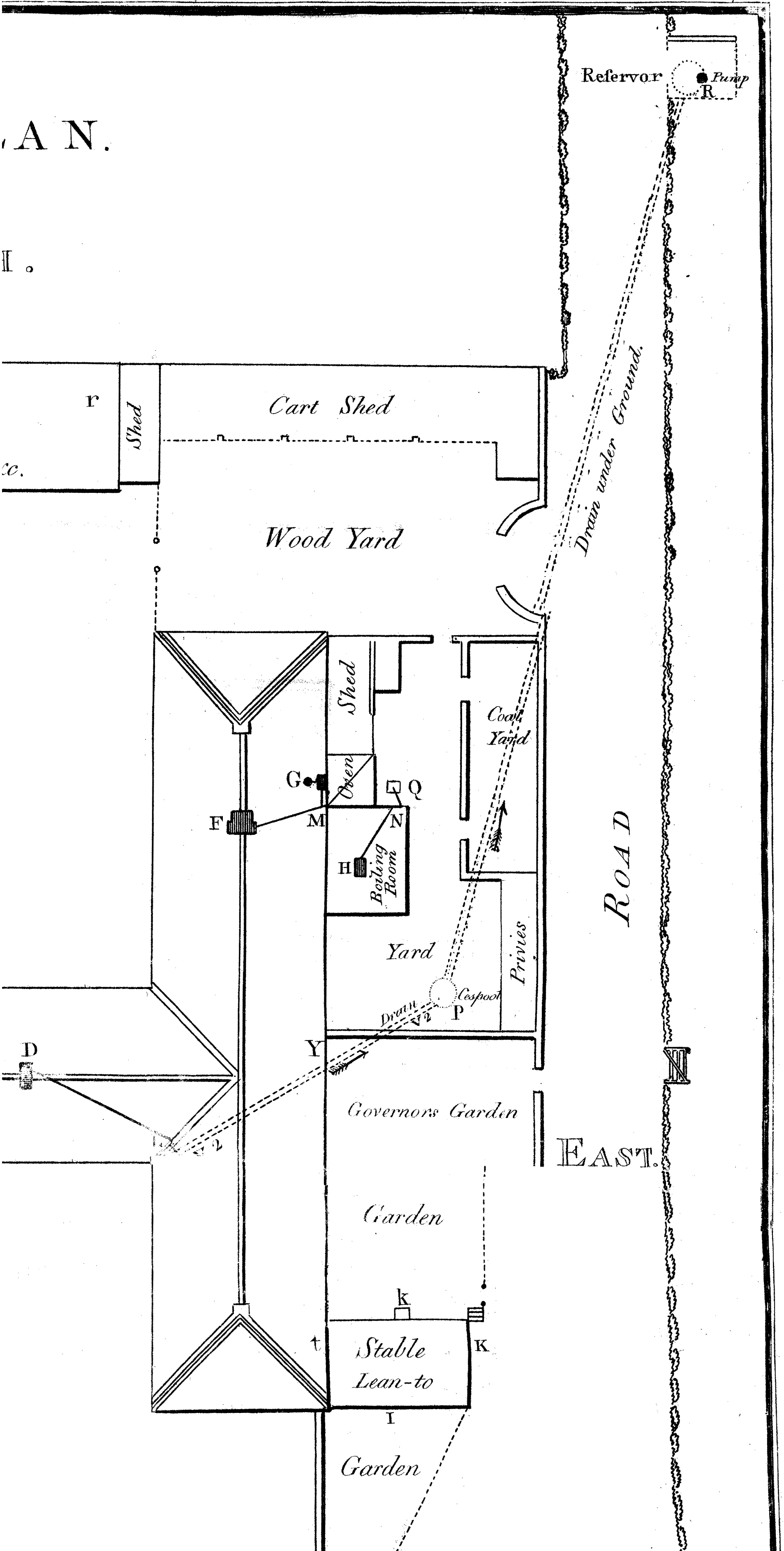
Such are the facts we were able to collect from an aſſiduous examination of the Poor-houſe at Heckingham, and of thoſe witneſſes in the neighbourhood who knew any thing of the accident. We have ſtated the appearances as they preſented themſelves to us, with all the minuteneſs that could be preſerved without too much crowding the narrative, and independently of any opinions. Whether the earth or the clouds were poſitive at the time; whether the top or bottom of the hip was firſt affected by the ſtroke; whether all the lightning took its courſe through the hip, or part went that way, and part through the conductor; and how far the conductors were properly conſtructed, or adequately terminated; are queſtions which will naturally ſuggeſt themſelves to your conſideration.

It

Fig. 1.

GENERAL PLAN




AN.
II.
Refervoir
Pump
R
r
Shed
Cart Shed
c.
Wood Yard
Drain under Ground.
Shed
Oven
G
Q
F
M
N
H
Boiling Room
Coal Yard
ROAD
Yard
Privies
Cespool
P
Drain
V 2
Y
D
V 2
Governors Garden
EAST.
Garden
k
K
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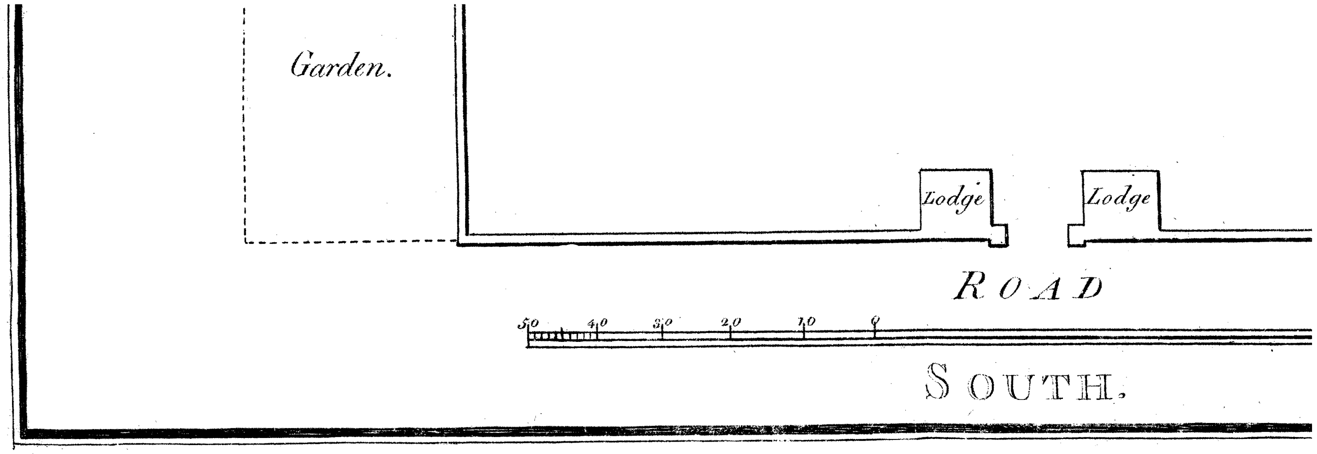
Stable
Lean-to
I
Garden


Garden.
Lodge
Lodge
ROAD
50
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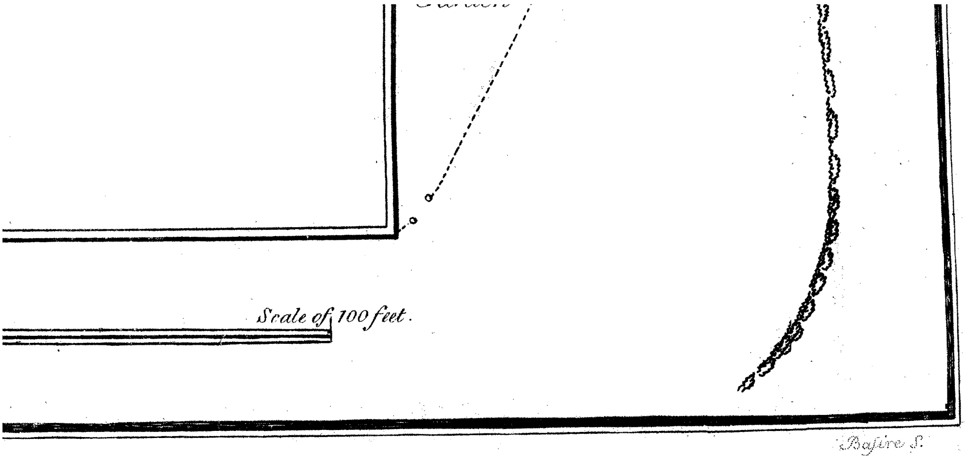
30
20
10
0
SOUTH.

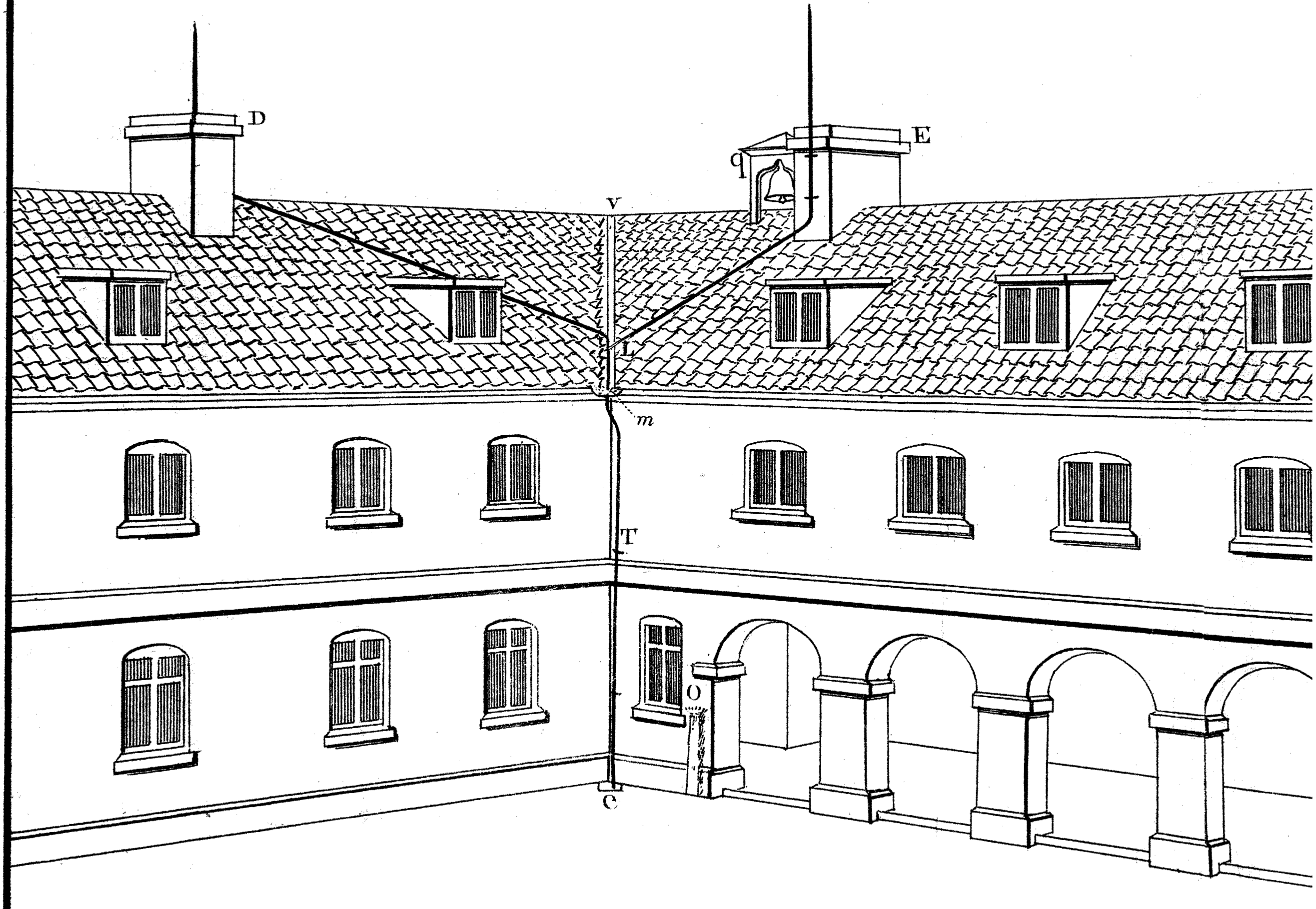


Basire S.

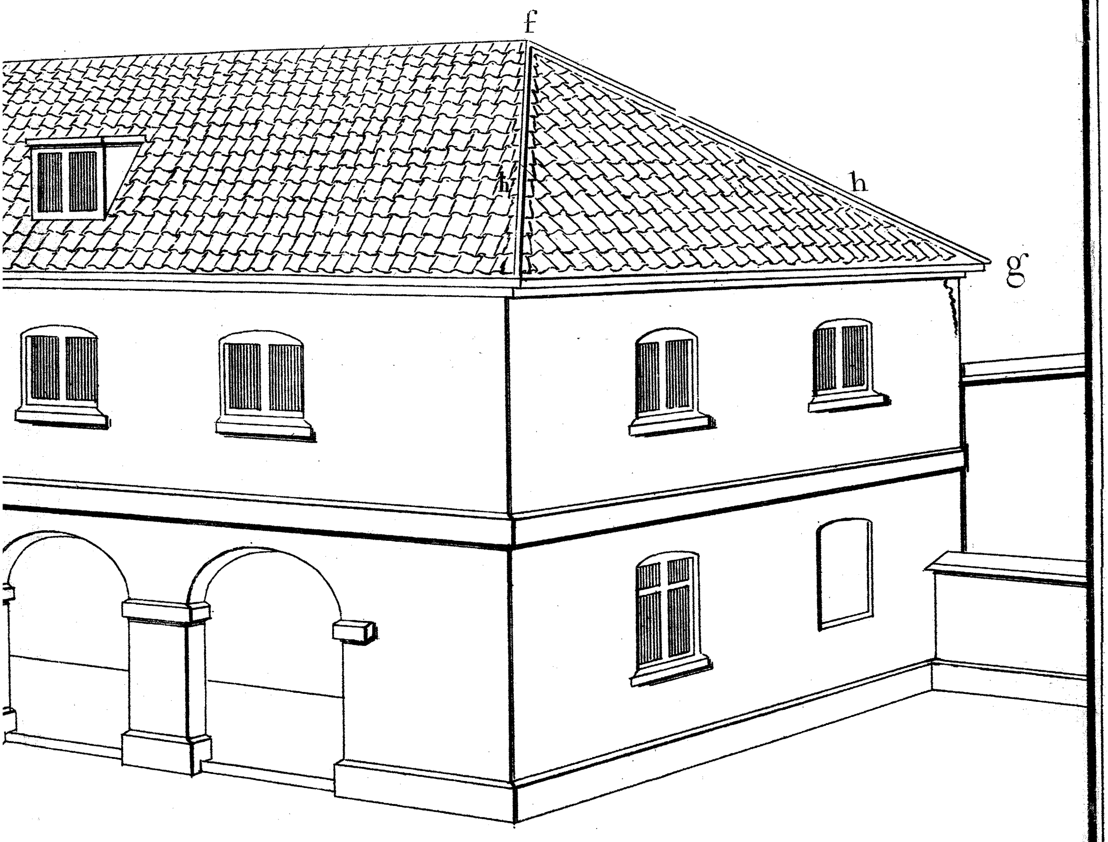
Fig. II.

SOUTH WEST VIEW of the EAST WING an

shewing the junction of the two Conducors tha

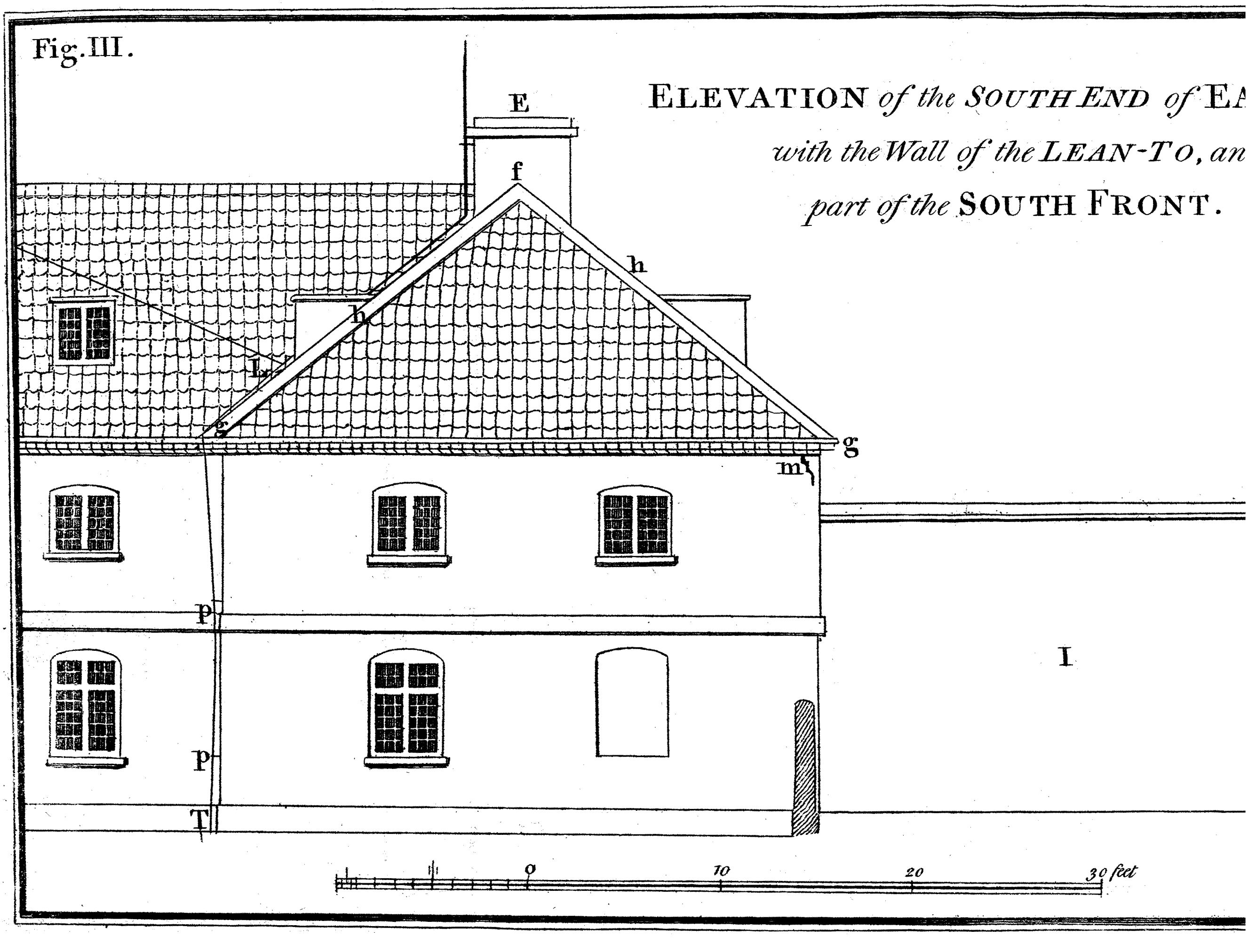


G and part of the CENTER RANGE
s that were nearest the Stable Lean=to.



Basire S.

Fig. III.



ELEVATION *of the* SOUTH END *of* EA
with the Wall *of the* LEAN-TO, *an*
part of the SOUTH FRONT.

of EAST WING,
TO, and
ONT.

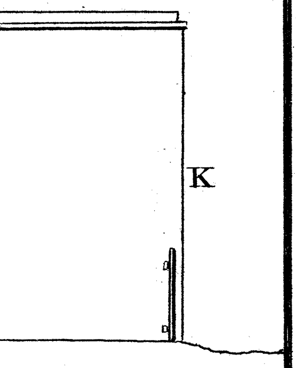
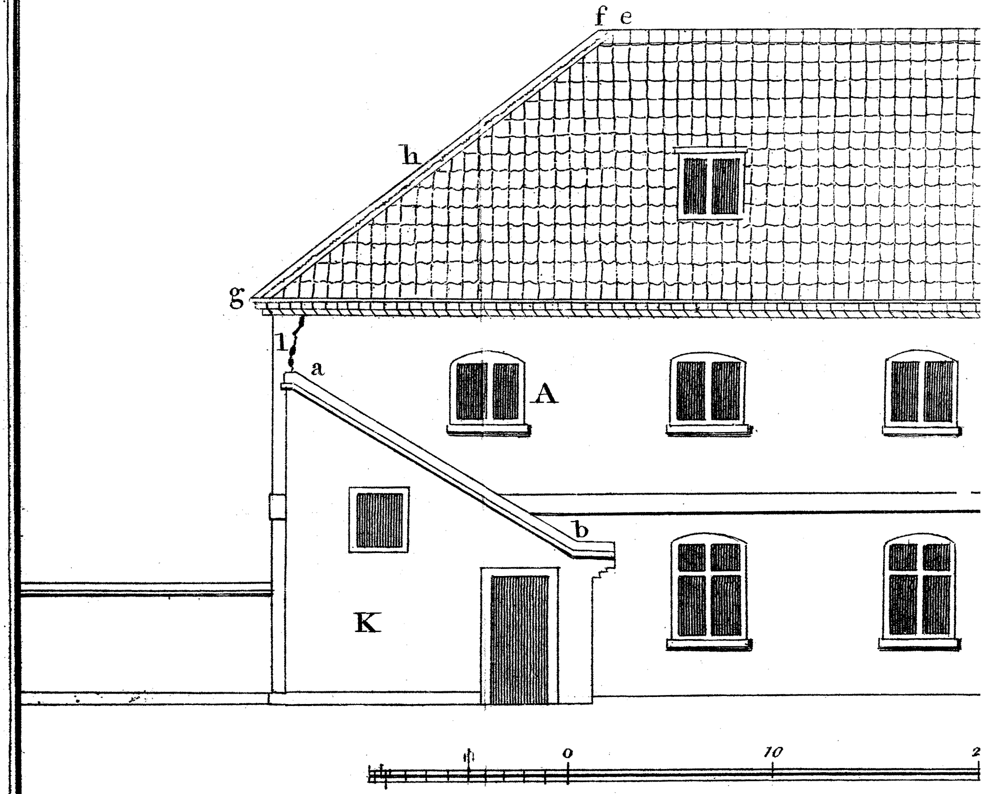


Fig. IV.

ELEVATION *of part of the* EAST F

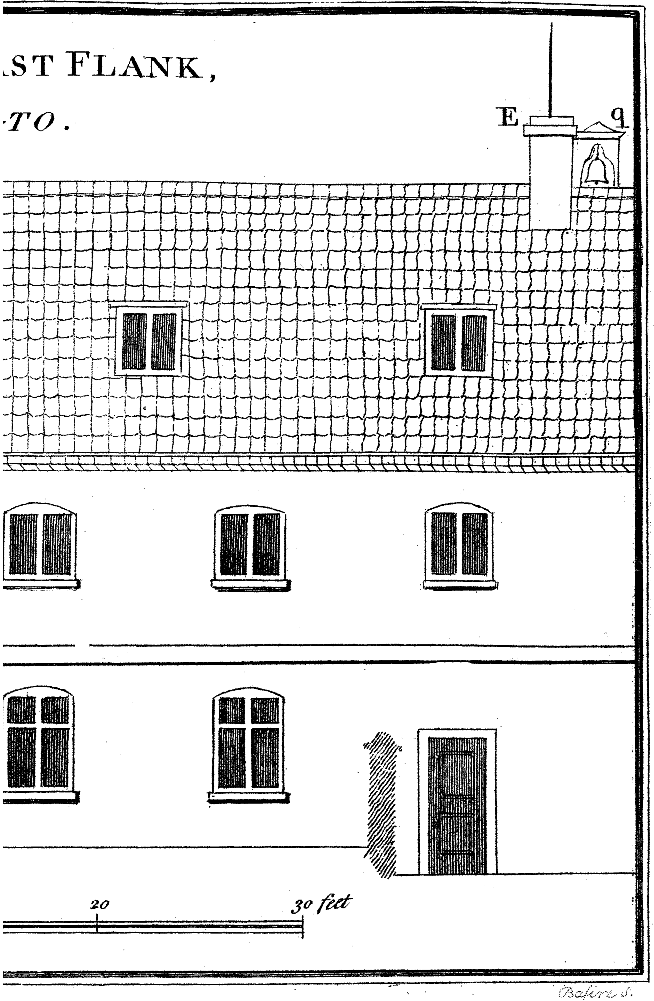
with the adjoining LEAN-TO.



Philos. Trans. Vol. LXXII. Tab. X. P. 378.

.ST FLANK,

·*TO*.



Basire s.

It may be proper, however, to add the two following pieces of information.

One of the cripples in the Houſe of Induſtry, a middle-aged woman, aſſured us, that at the time of the accident, as ſhe was looking from the door of the hall (which is in the center of the front facing the ſouth), ſhe ſaw three balls of fire dart down; that one fell exactly oppoſite her; a ſecond ſeemed to ſtrike the corner of the houſe; and the other deſcended in the direction of a door in the eaſtern flank, which was not far out of the perpendicular line of the chimney E (ſee the general plan, fig. 1.). If any credit could be given to the teſtimony of ſuch a perſon in a matter like this, it would incline us to believe, that the exploſion was made in three ſtreams, of which one paſſed through the conductor of the chimney E, and another through the damaged corner of the houſe; whilſt the third fellon the ground, or, as the woman deſcribed it, on the great gate of the fore court near the lodges (ſee the general plan, fig. 1.). We examined the gate and lodges, with the adjacent parts, but could no where diſcover any marks of injury; nor could we learn that any place in the neighbourhood had been ſtruck, or that any perſon, except this woman, pretended to have ſeen the courſe of the lightning.

In our return to town, through Norwich, we ſaw an ingenious gentleman of that city, who ſays, that he found the clouds negative there on the day of the accident at Heckingham. The two places are diſtant about eleven miles by the road.

It would be unpardonable to conclude this Report, without expreſſing our obligations to the Directors and Guardians of the Houſe of Induſtry at large, and to the neighbouring

Gentlemen in particular, for the liberal manner in which they ſeconded our endeavours to execute the commiſſion with which you had charged us. By their kind aſſiſtance proper workmen were provided; and every accommodation afforded us, that could contribute to the inveſtigation of this remarkable accident.

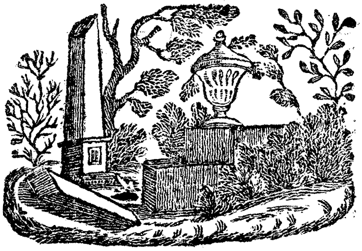
We have the honour to be,

GENTLEMEN,

Your moſt obedient humble ſervants,

C. BLAGDEN.
EDW. NAIRNE.

London, Feb. 7, 1782.



SECTIONS *and* PLAN *of th*
of the Conductor at the Sou
of the BUILDIN

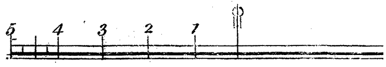


Fig. V.

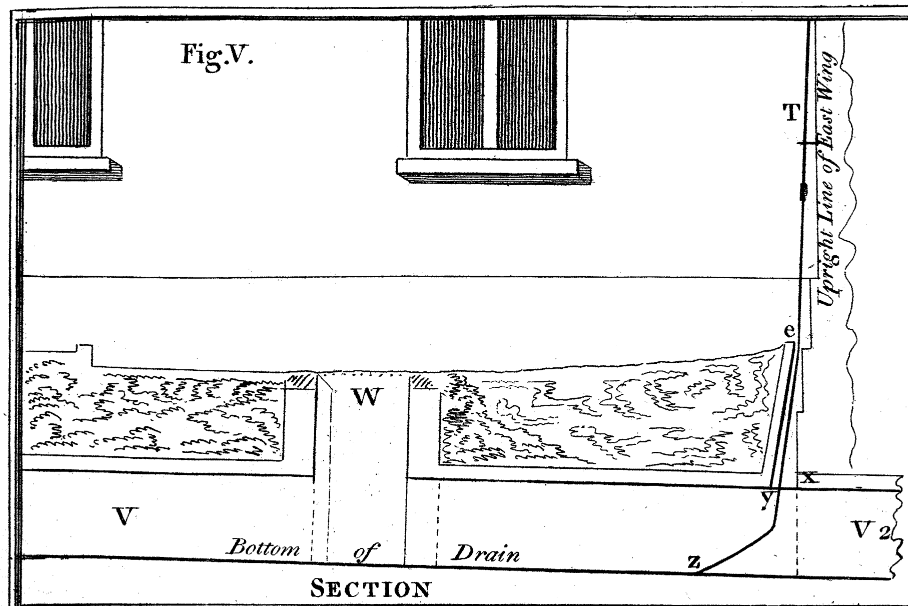


Fig. VI.

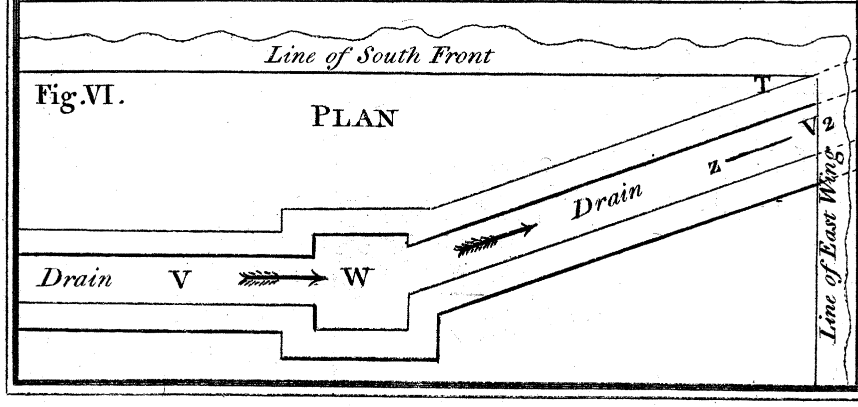
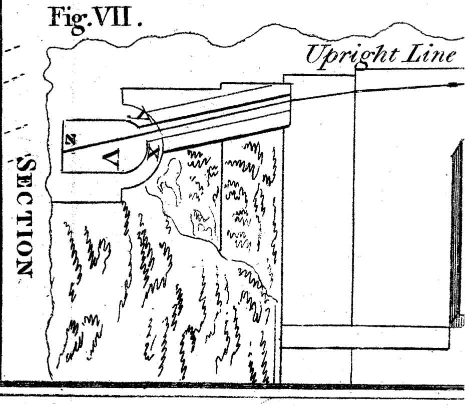
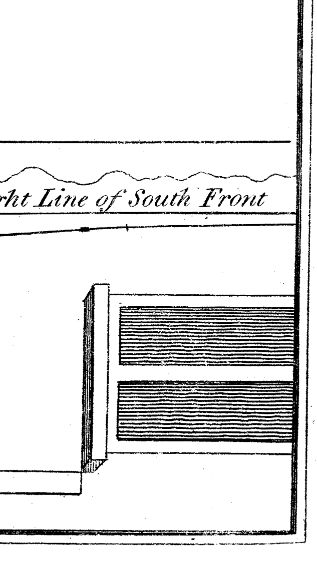


Fig. VII.



AN *of the termination*
the South-East Angle
ILDING.



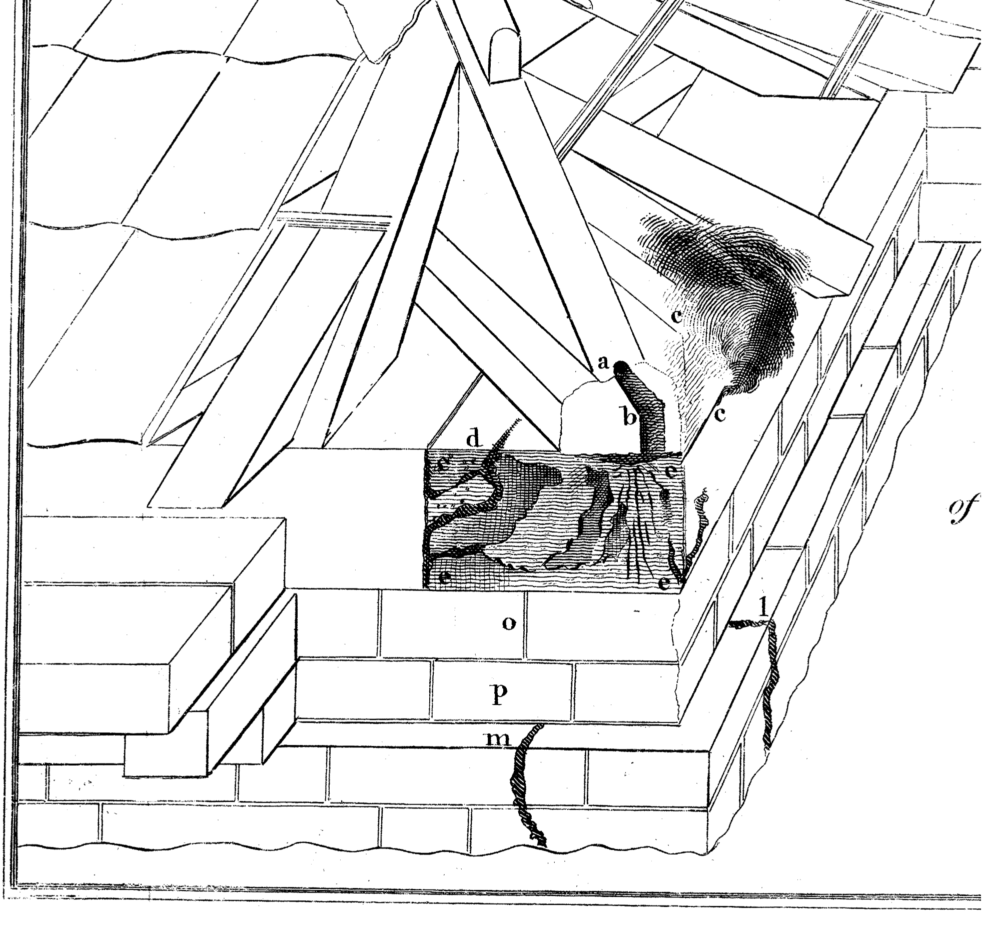


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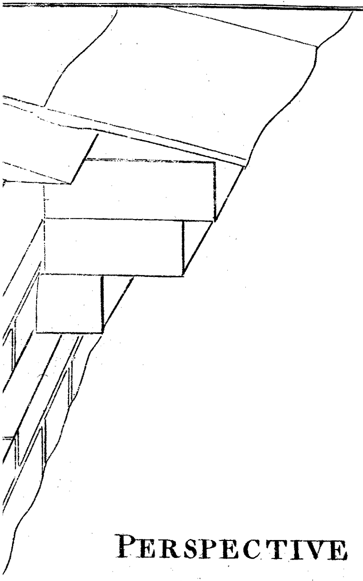
Fig. VIII.



PERSPECTIVE VIEW
of the End of the Wall Plate and
part of the Rafters.

Basire S.

Fig. XII.

FULL SIZE of the CONDUCTORS,
shewing the manner of their being jointed.

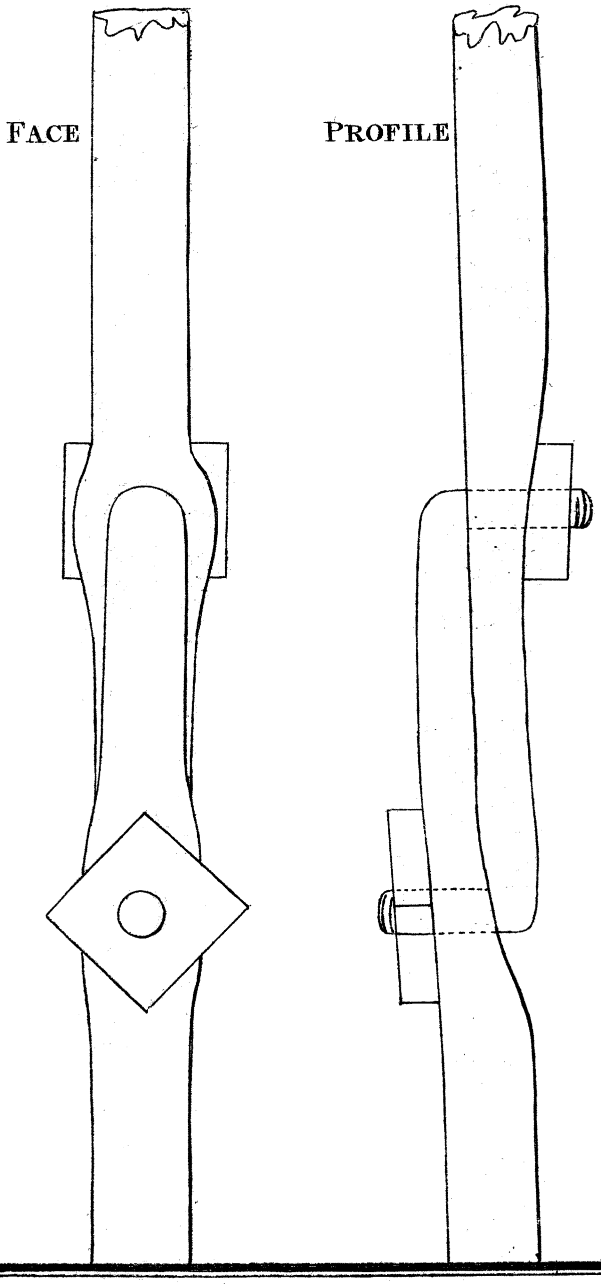


Fig. X.

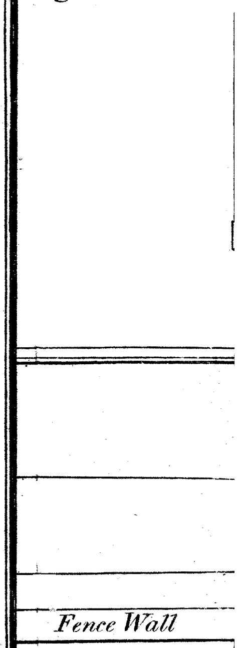
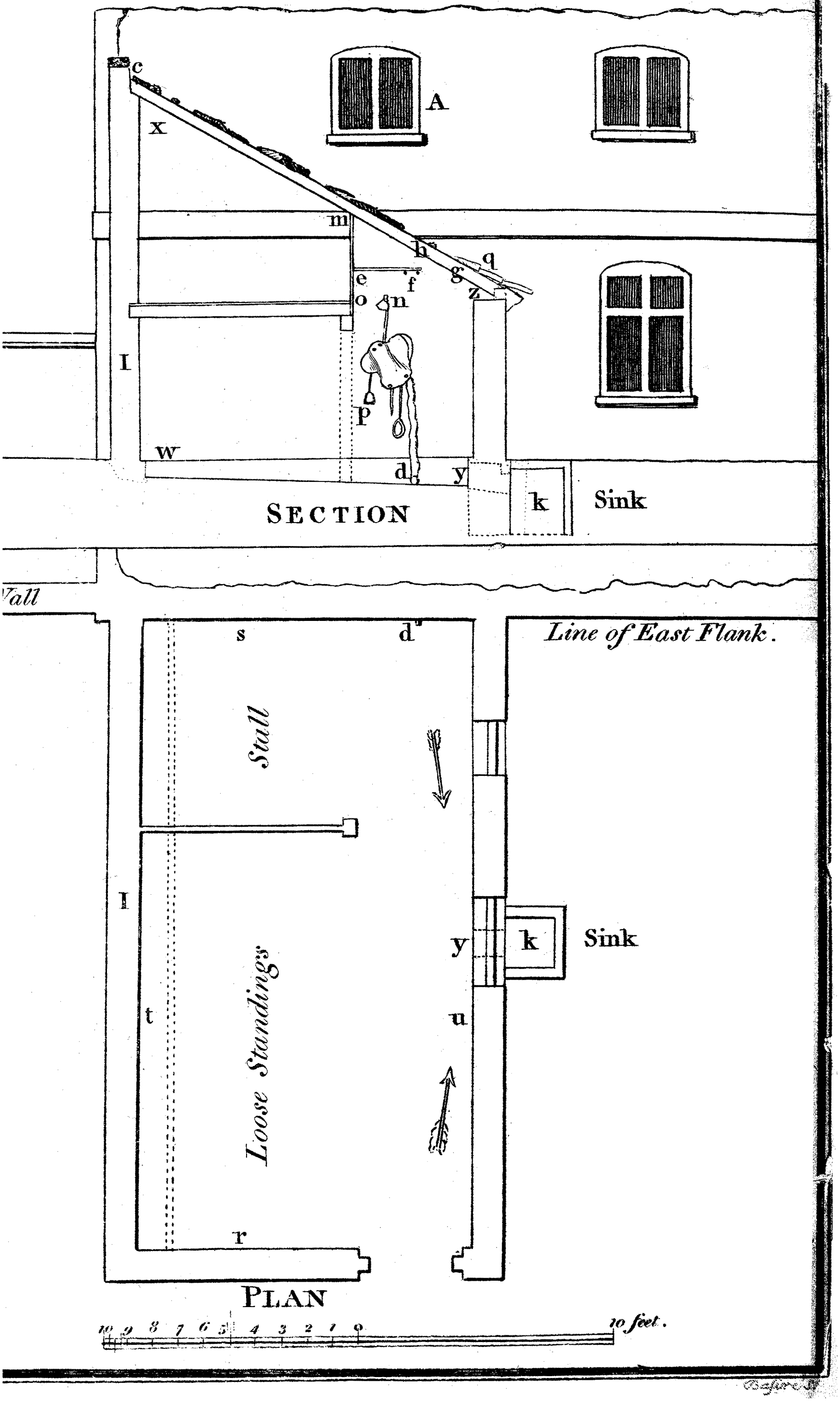


Fig. IX.

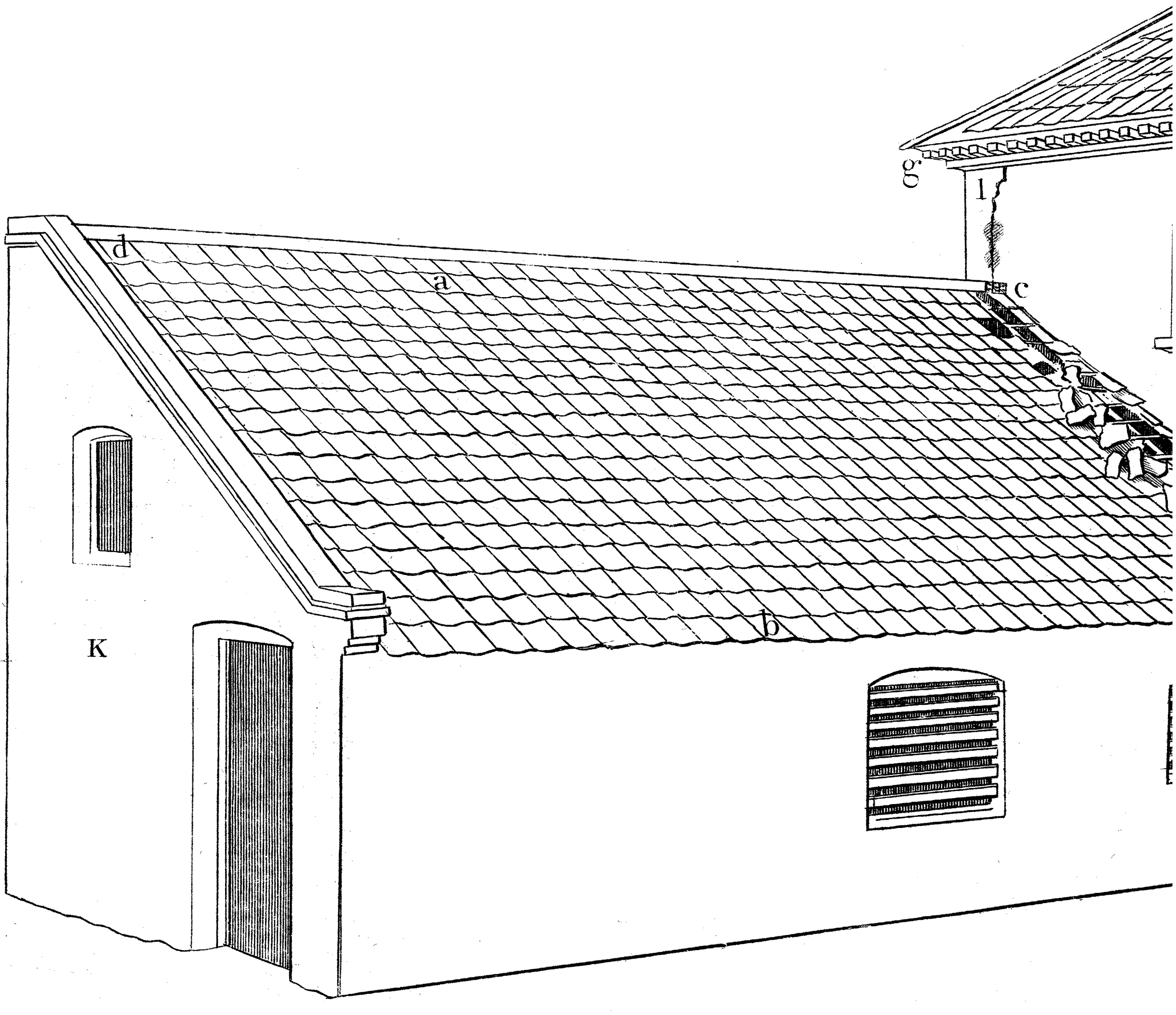
PLAN *and* SECTION *of the Stable Lean-to.*

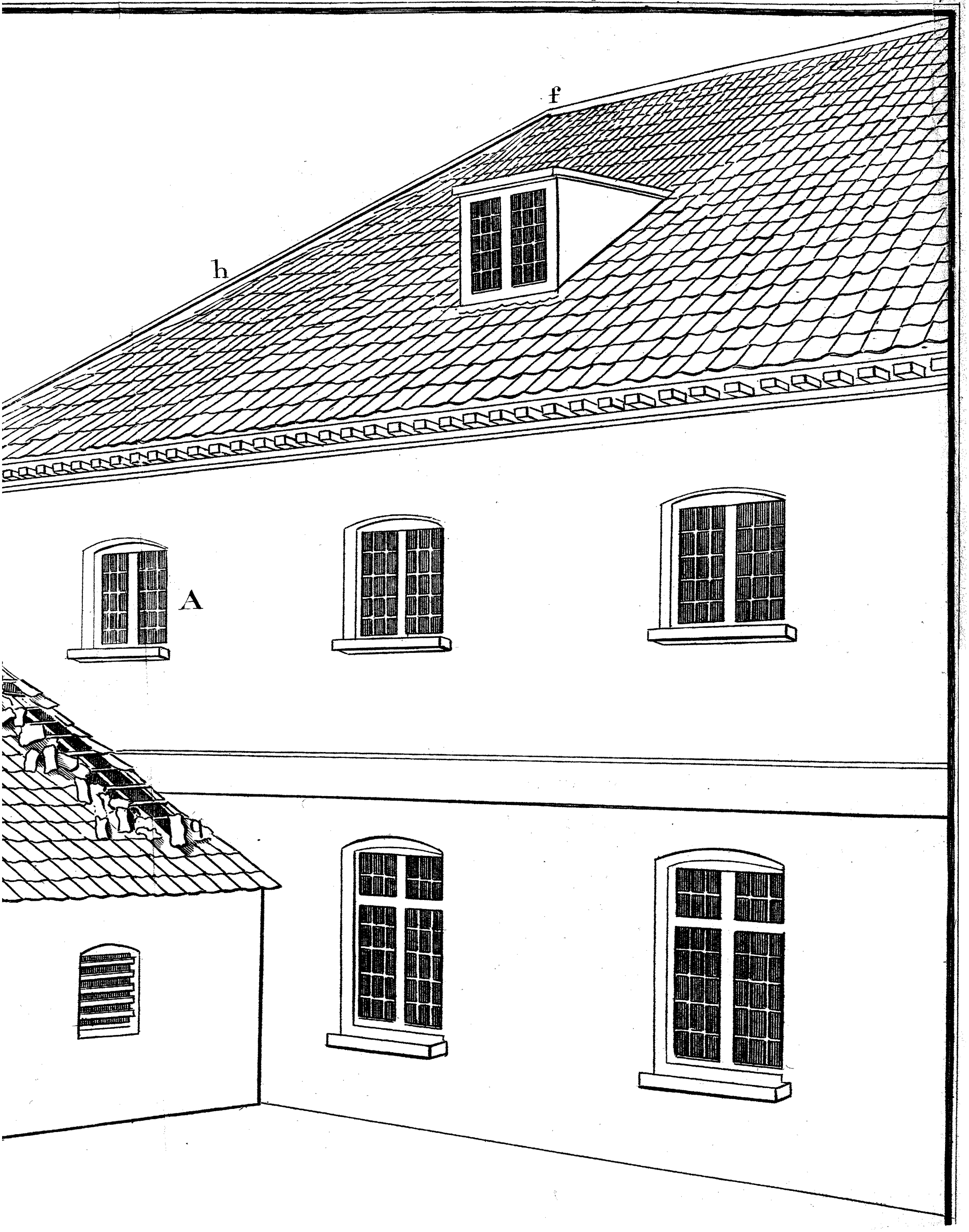


Basire Sc.

Fig. XI.

NORTH-EAST VIEW *of the STABLE LEAN-TO and part of the EAST FLANK.*

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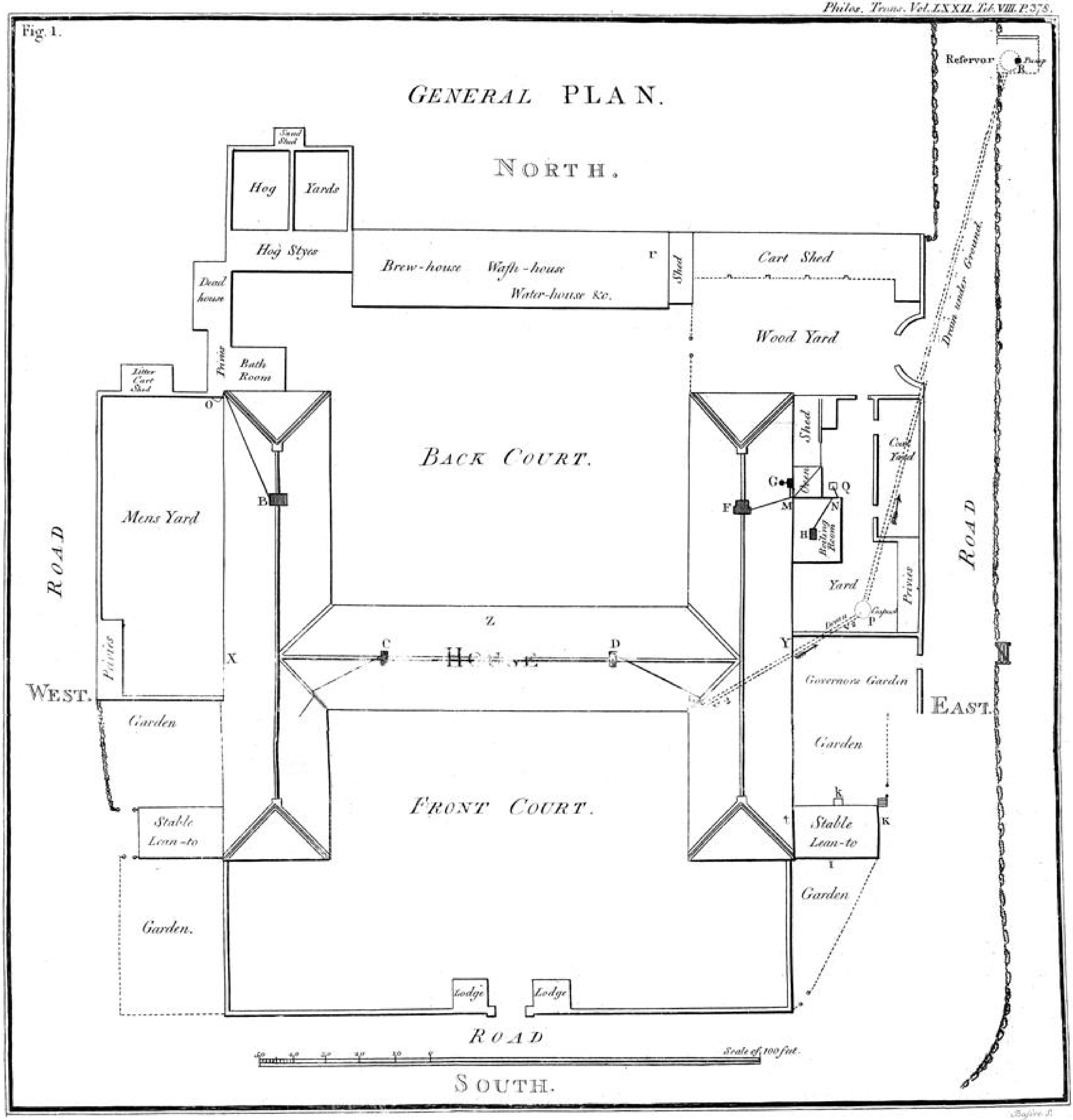
A

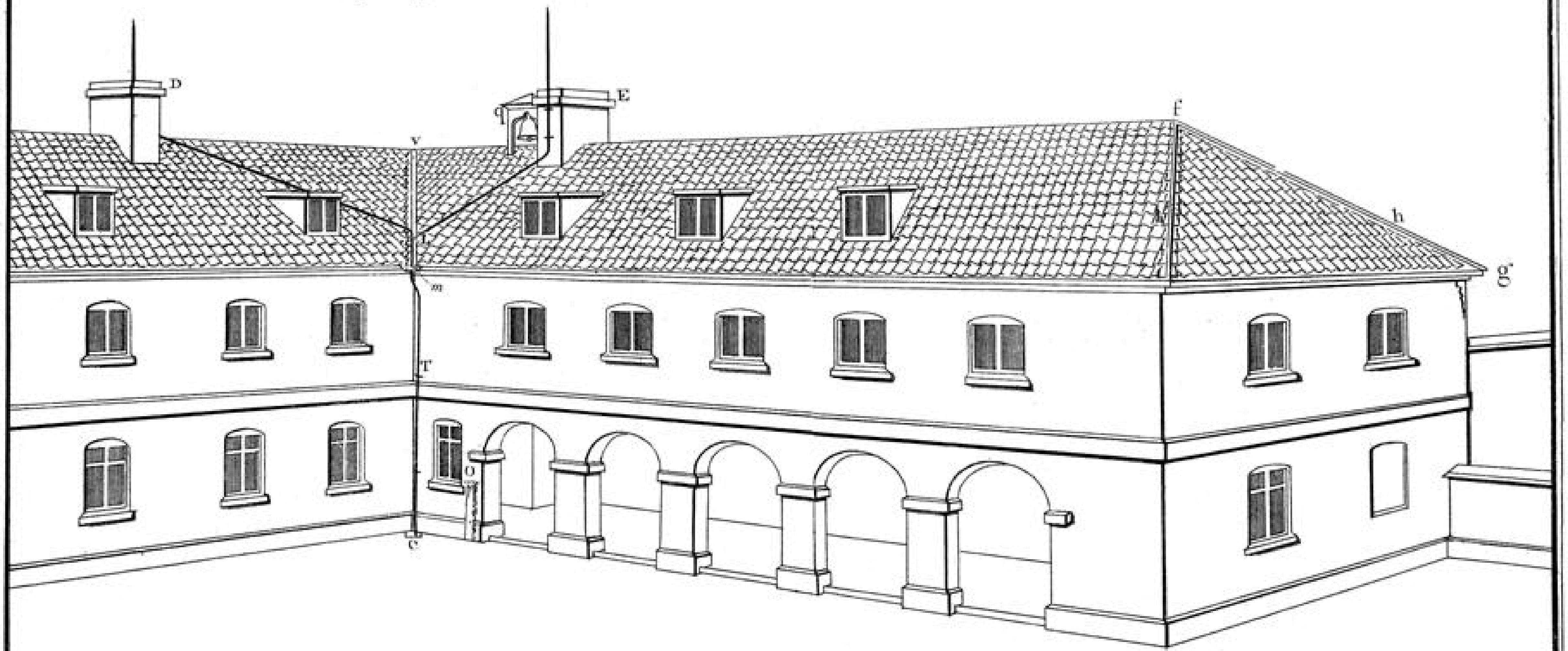
Fig. 1.



Basire S.

Fig. II.

SOUTH WEST VIEW of the EAST WING and part of the CENTER RANGE shewing the junction of the two Conducors that were nearest the Stable Lean-to.



Basire s.

Fig. III.

ELEVATION *of the* SOUTH END *of* EAST WING, *with the Wall of the* LEAN-TO, *and part of the* SOUTH FRONT.

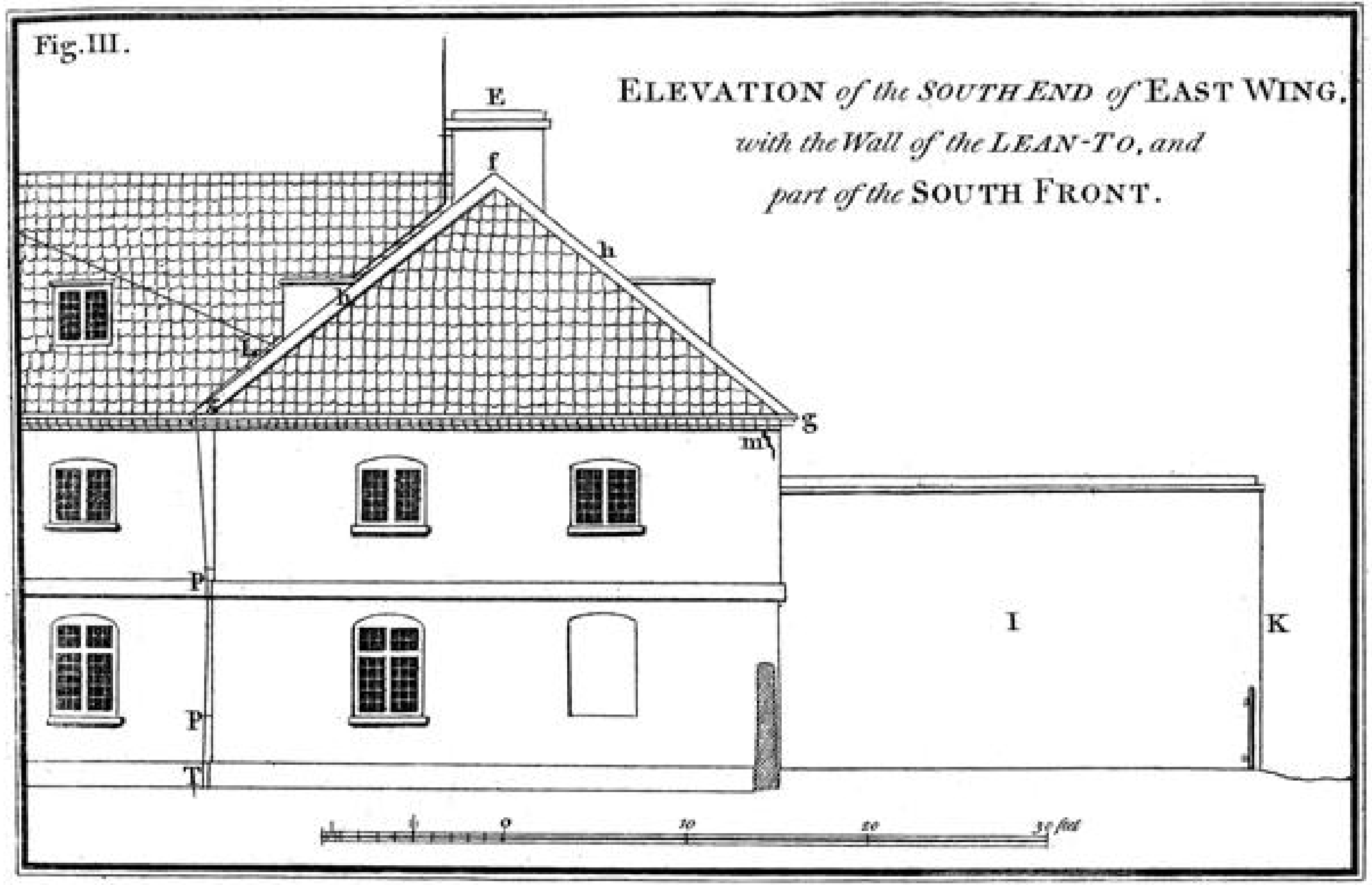
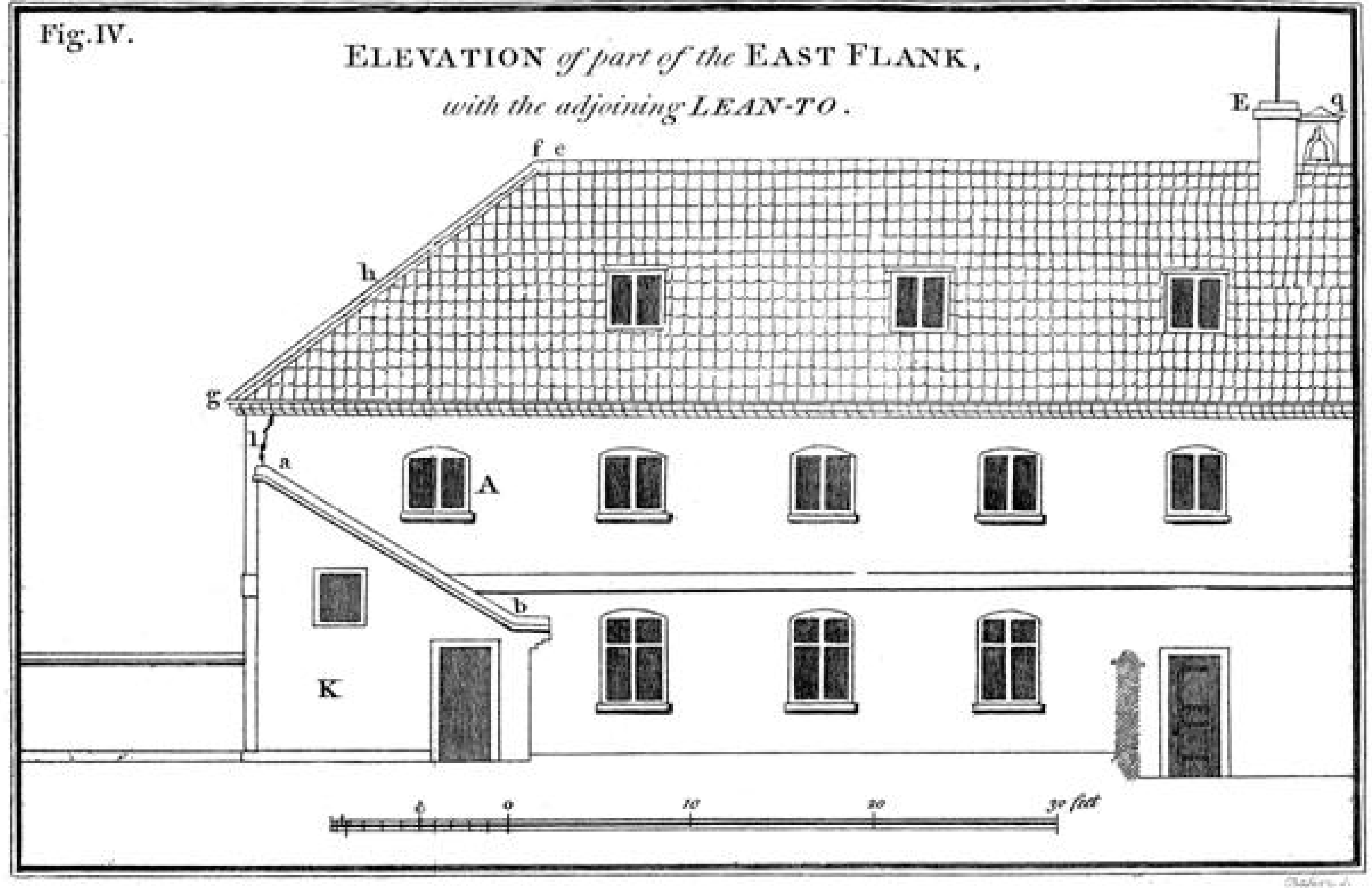


Fig. IV.

ELEVATION *of part of the* EAST FLANK, *with the adjoining* LEAN-TO.



Basire sc.

SECTIONS *and* **PLAN** *of the termination of the Conductor at the South-East Angle of the* **BUILDING.**

Fig. V.

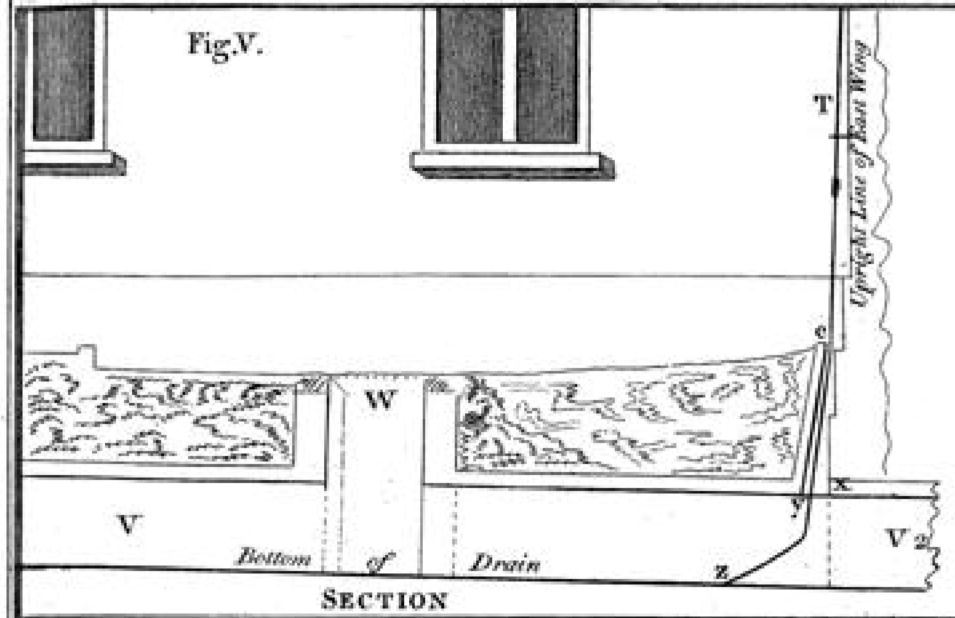


Fig. VI.

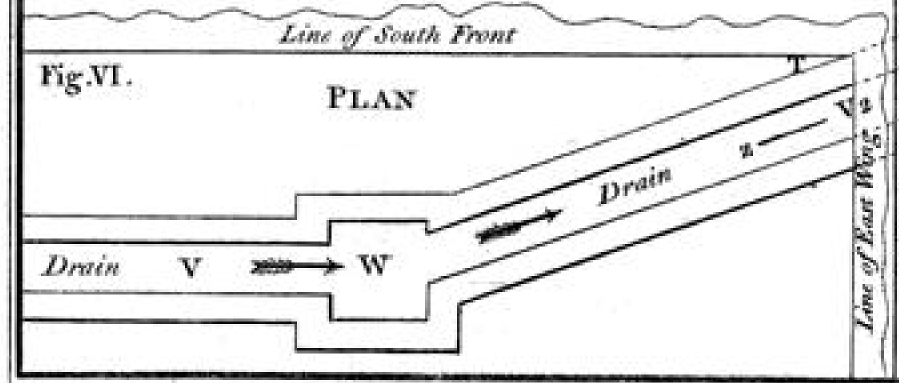


Fig. VII.

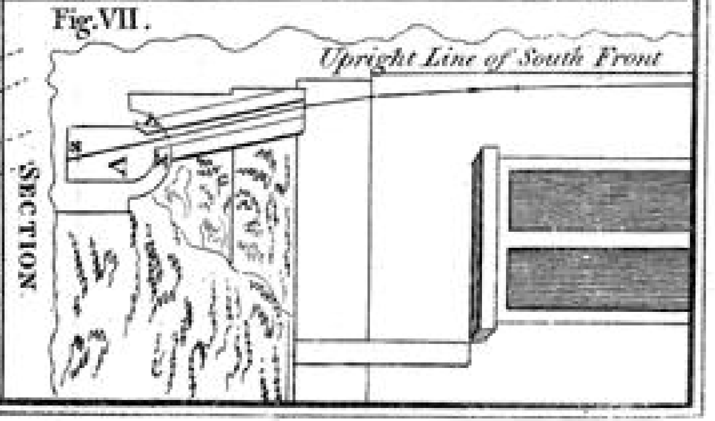
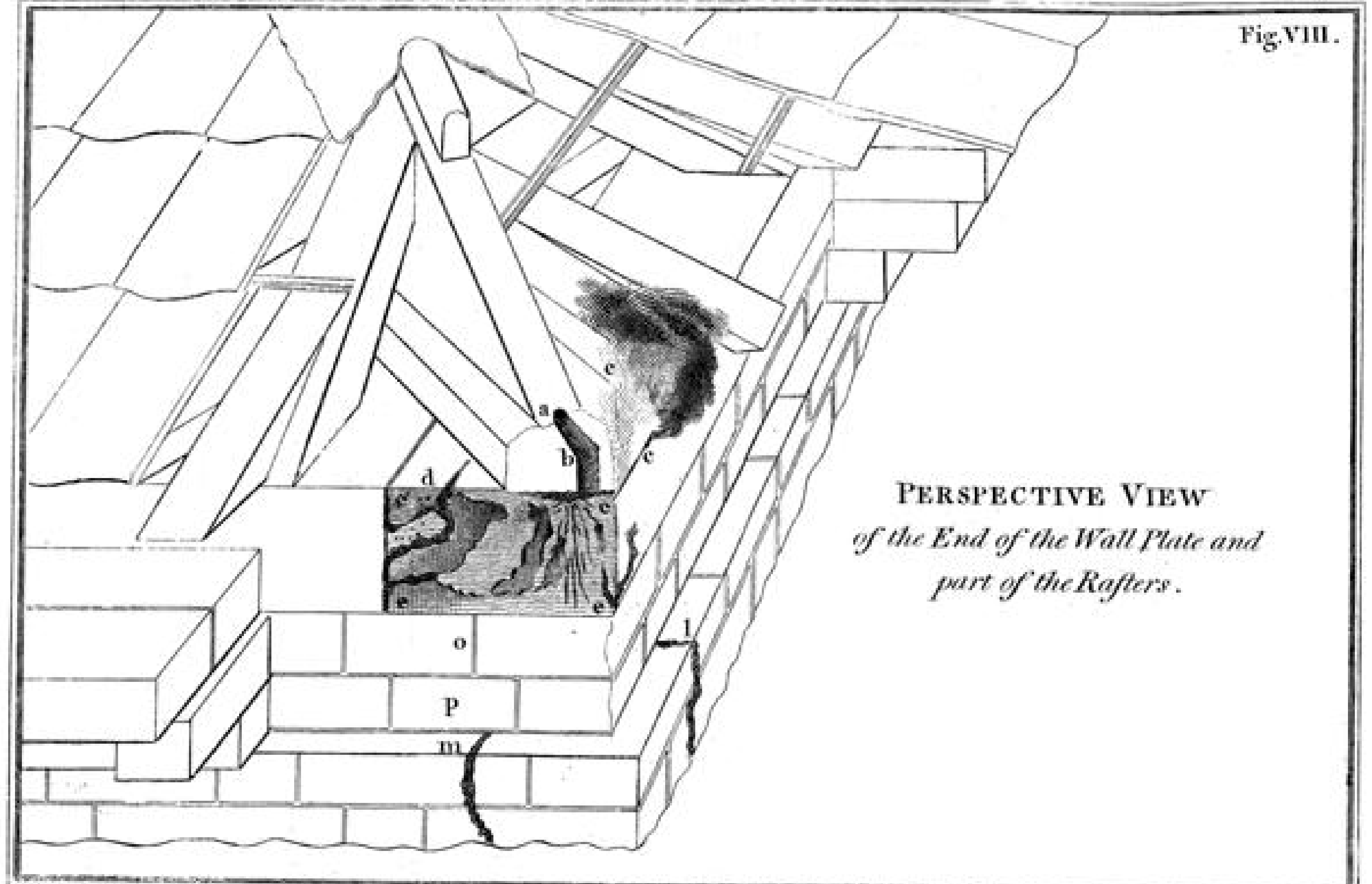


Fig. VIII.



PERSPECTIVE VIEW *of the End of the Wall Plate and part of the Rafters.*

Baſire ſ.

Fig. XII.

FULL SIZE of the CONDUCTORS, shewing the manner of their being jointed.

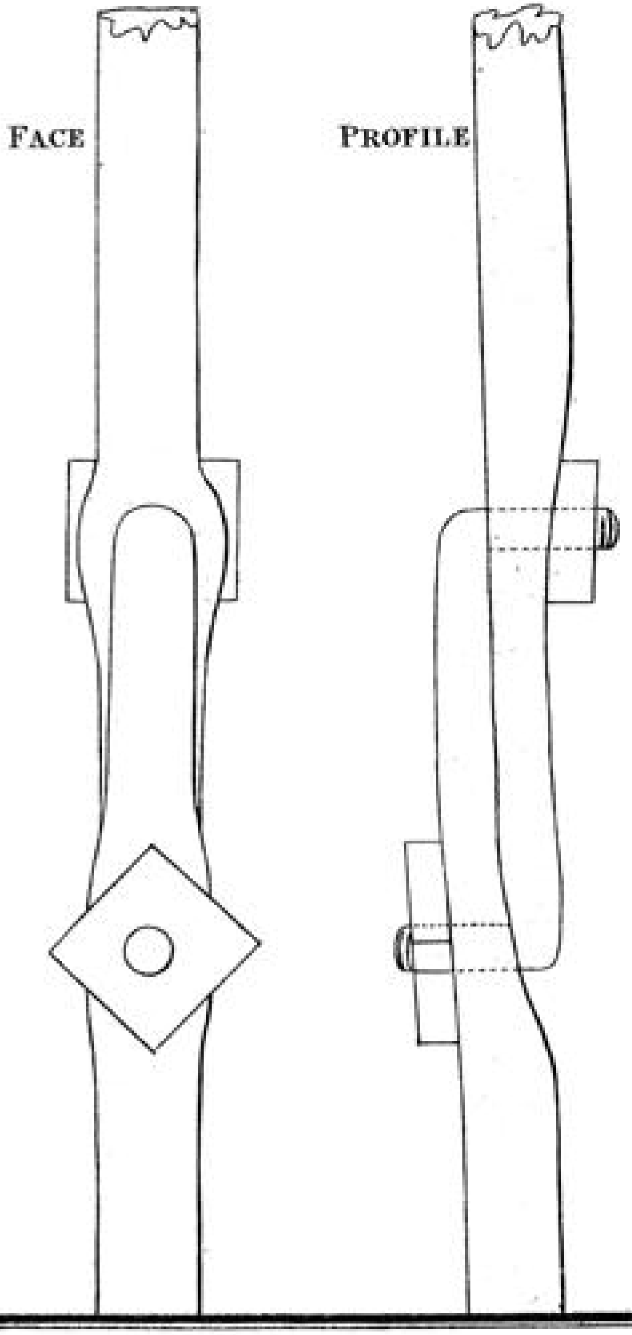


Fig. X.

PLAN *and* SECTION *of the Stable Lean-to.*

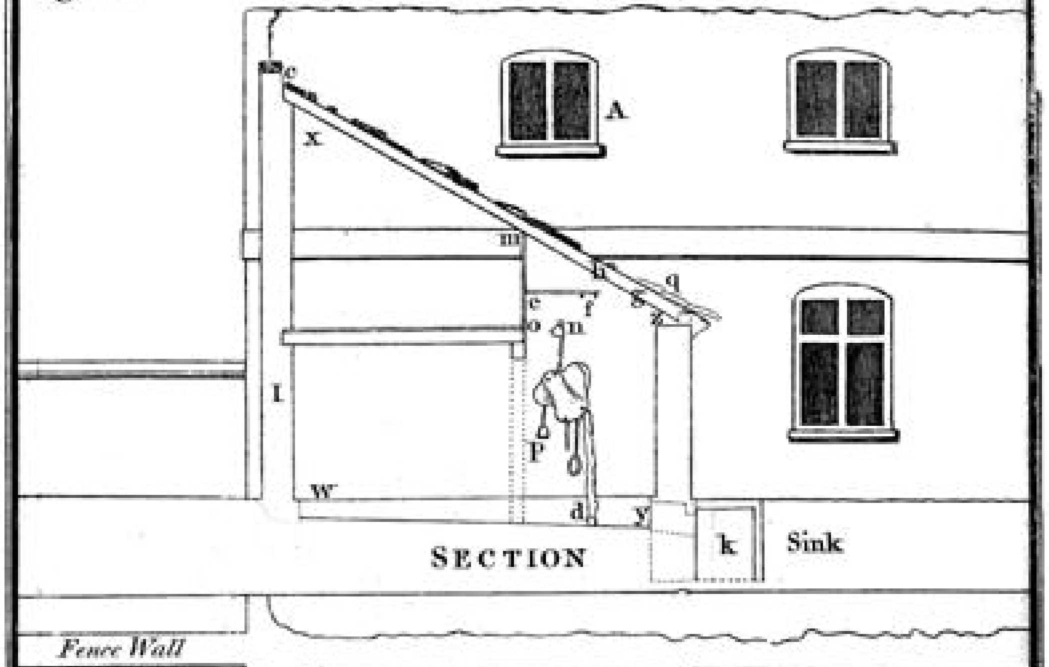


Fig. IX.

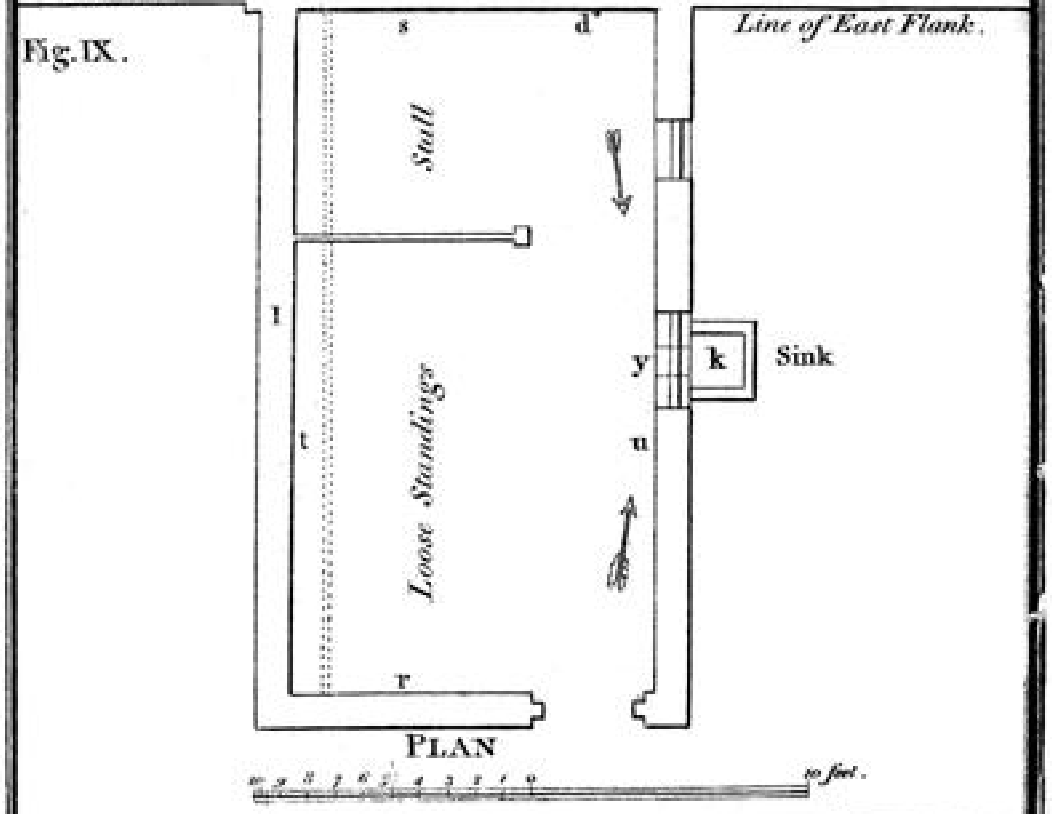


Fig. XI.

NORTH-EAST VIEW of the STABLE LEAN-TO
and part of the EAST FLANK.